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The Utility of ACT Based Apps in Healthcare

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Doctorate in Clinical Psychology

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I would like to thank all participants who took the time to take part in the study, and to the diabetes team who also helped with recruitment. I would like to thank Sarah Ross for her continuous encouragement throughout the trials and tribulations of recruitment. I would like to thank David Gillanders for his continual support throughout the challenges faced throughout training both personally and professionally. His insights and knowledge helped me to develop my research skills and have given me a space to reflect on my values which has helped me stay dedicated to the cause. I have experienced some great supervisors in training whom I have learnt an abundance from.

I would like to thank all my friends and family for always being there to pick me up, and who have encouraged me throughout the process of training.

Dedication

I would like to dedicate this to my mum and Hugh who I admire and thank for their devotion throughout my life. My sister who is always there for me no matter what. Also to Steve who is the most dependable and supportive partner I could ask for.

(Overall word count: 14,972)

Contents

Lay Summary

Background: There are significant psychological challenges faced by people throughout their lives and many of these challenges can be readily understood from a contextual behavioural science perspective, and Acceptance and Commitment Therapy (ACT) shows promise as a theoretically and practically relevant intervention. Some problems faced in delivering such an intervention are volume and access to healthcare. A potential solution to this is to design theoretically driven interventions which can be delivered through technology. These need to be interactive, individually shaped and will combine mindfulness, acceptance and values. Such interventions need to be evaluated scientifically according to acceptability, quality, safety and effectiveness.

Aims: This thesis has two sections. Firstly, a systematic review aiming to assess the acceptability and effectiveness of using technology to deliver ACT. Secondly, an empirical research study aiming to analyse the experiences of using an ACT based app for young people with type 1 diabetes (TD1).

Methods: The review searched 11 databases, and a related website. Included studies were required to use a form of technology to deliver ACT, with no real-time therapist. Two independent researchers determined inclusion of articles into the review and rated the studies according to the quality criteria. Where there was uncertainty a third reviewer was used. For the empirical study, individual interviews of 9 young people aged 13-22 years with TD1 were asked about their experiences of using the ACT based app. Framework analysis was used to determine themes.

Results: The review search yielded 18 studies which met inclusion criteria. Findings highlighted that generally these interventions were seen as acceptable and satisfactory. All of these interventions were conducted in an adult population, and qualitative data was not robustly accounted for. The empirical research found two main themes: 'Desire for apps to represent my needs' and 'How diabetes impacts me and how this could potentially be addressed in an app'.

Discussion: Both the review and empirical study found that participants were positive about the use of technology to deliver ACT. Developmental progress needs to be made in the app to truly represent the needs of young people with TD1. These interventions could enhance the availability of psychological therapies. This has been highlighted as a government objective in several countries. Methodological weaknesses limit conclusions, such as underpowered studies. As this is a fast growing body of research it is hoped that future studies could be more similar methodologically. It would still be interesting to determine whether asynchronous contact enhances the cost-effectiveness of this form treatment.

Introduction to the Thesis

This thesis has provided me with the opportunity to design an ACT protocol for young people with type 1 diabetes (TD1). It has helped me to fully understand the undertaking which goes into designing apps and the scope of how responsive apps can be. It has given me the chance to communicate with people from different professional backgrounds to create a shared language, an opportunity to lead and manage a project and much more. With the help of my supervisor in my first year of training, we established links with the informatics department to see if students would be able to help with the programming of such an app. We had to create a synopsis of the proposed study to entice students to undertake the project as part of their degree. An interested student was assigned the project and meetings were held to determine our expectations and to establish the scope of what could be created. A second student took on the project during my second year or training. During this time my supervisor and I created a protocol of the content for the app. This was based on previous ACT protocols and tools we were aware of, which we thought might be helpful. A lot of thought had to go into trying to keep the content concise, including different modes of delivery (MP3s, video, animation etc), making the content applicable to young people with TD1 based on previous literature, and thinking about how interactive the app could be. Friends were also relied on to create graphics for the app. I went to different health boards across Scotland to meet with Diabetes teams to inform them about the project and to gather advice on the appropriateness of the diabetes information within the content of the app, and to determine whether they were interested in taking part in the study. I tested the initial prototype and glitches were ironed out. The next stage was to test the app on professionals working in the field, and to gather their feedback through focus groups. Adaptations to the app were made based on this. The app was initially made for Android phone devices based on general market research indicating that there was little evidence that one platform was more popular in adolescents. The diabetes teams and I tried to recruit young people with TD1 from their usual diabetes clinics. Initial barriers to recruitment were that at least 50% of young people had iPhones so could not download the app, and others did not seem interested in downloading the app to take part in the study. Funding of 10 Android tablets was agreed by the University. I attended the usual diabetes clinics in NHS Lothian and young people with TD1 started to volunteer to take part in the study. Originally it was hoped a trial of the effectiveness of the app would be carried out, but the difficulties in recruitment meant that instead I decided to use a qualitative methodology to explore young people's experiences of using the app.

List of Tables and Figures for Systematic Review

List of Appendices for Systematic Review

List of Tables for Empirical Paper

List of Appendices for Empirical Paper

Overall Appendices

Overall Abstract

Background: There are significant psychological challenges faced by people throughout their lives and many of these challenges can be readily understood from a contextual behavioural science perspective, and Acceptance and Commitment Therapy (ACT) shows promise as a theoretically and practically relevant intervention. Some problems faced in delivering such an intervention are volume and access to healthcare. A potential solution to this is to design theoretically driven interventions which can be delivered through technology. These need to be interactive, individually shaped and will combine mindfulness, acceptance and values. Such interventions need to be evaluated scientifically according to acceptability, quality, safety and effectiveness.

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Key words: Acceptance and Commitment Therapy, Apps, Type 1 Diabetes, Adolescents, Online, Smartphone

Systematic Review

Acceptability, Utility and Effectiveness of using Technology to Deliver Acceptance and Commitment Therapy: A Systematic Review

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[1] The collaborating authors are for the journal article only. Kate Randell's contributions were to generate a consensus on the quality criteria and for the markings of this with 50% of the papers. David Gillanders was my academic supervisor.

Abstract

Introduction: As society increasingly embraces the use of technology in everyday life, psychological scientists seek to explore how the delivery of psychotherapy might evolve to capitalise on this trend. Indeed this has been highlighted as an effective way to promote self-help and lower intensity therapy in the UK for Cognitive Behavioural Therapy (CBT). A recent development in CBT is Acceptance and Commitment Therapy (ACT), yet like other therapies, a common problem faced in delivering ACT is one of volume. Therefore research into delivery through different modalities such as the internet or smartphones has progressed. This review aims to consider whether such interventions are acceptable and effective.

Methodology: This review searched for pilot, comparison or control trials on PsycInfo, Embase, OvidMedline, PsycArticles, YourJournals@Ovid, Journals@Ovidfulltext, Scopus, Web of Knowledge, and the website of The Association for Contextual Behavioural Science. It placed no restrictions on age, ethnicity, gender or intervention for particular condition. Delivery of ACT was by the internet or smartphones. Real-time therapists were an exclusion. Two independent researchers determined inclusion of articles and rated the studies according to the quality criteria. If there was uncertainty a third reviewer was used.

Results: The search yielded 18 studies which met inclusion criteria. The focus of the studies generally focused on mental or physical health. Thirteen studies used an internet only intervention, three used smartphone only. Ten studies reported on adherence to the intervention. This ranged from 27.5 %-92%, with one exception. Four studies compared satisfaction between groups. All found ACT delivered via technology had higher satisfaction than control groups. Where there were no control groups, patients rated they were satisfied with this form of treatment. The majority of studies found medium-large effects on primary outcome and process measures.

Discussion: It appeared that the use of technology was deemed acceptable and effective in delivering ACT and could enhance the availability of psychological therapies. This has been highlighted as a government objective in various countries. Methodological weaknesses limit conclusions, such as underpowered studies. As this is a fast growing body of research it is hoped that future reviews would compare more methodologically similar studies, and determine whether asynchronous contact enhances the cost-effectiveness of this form treatment.

Key words: Acceptance and Commitment Therapy, Internet, Online, Web, Smartphone, Application

Introduction

Traditionally, psychological therapies are delivered face-to-face with an individual therapist. As practice has evolved the mode of delivery has incorporated alternative ways to deliver therapy such as group therapy, which has become a recommended treatment across a number of disorders (NHS Education for Scotland, 2011; NICE, 2009). Indeed, improving access to psychological therapies is seen to be a worldwide issue (Richards & Bower, 2011), and is highlighted in several research studies and service planning policy statements. For example Peachey, Hicks and Adams (2013) highlight the need for greater integration of psychology within treatment for mental health conditions. Documents such as these have led to developments such as 'Improving access to psychological therapies' (IAPT) in NHS England, the 'Australian Better Access Initiative' (Australian Government, 2010), and 'Recommendation from the Community Preventive Services Task Force for Use of Collaborative Care for the Management of Depressive Disorders' (2012). However, these initiatives do not necessarily improve access for people in more remote and rural areas. This need has been identified in 'The Delivering for Health' document (Scottish Government, 2005) and the 'Rural mental health, stigma, services and supports within the SWARD Region' (Donaghy, 2012). It is further highlighted in Australia where there is a difference between rural and urban physical and mental health, due to social deprivation, access to healthcare and potentially lower help seeking in rural communities (Vine, 2011). Therefore research has been conducted using technology to deliver psychological treatment. For example therapy has been adjusted for effective delivery through mediums such as video conferencing (e.g. Skype), self-help with telephone support, 'multi-functional' text-messaging interventions and online virtual environments, which have all been found to be effective (Free et al., 2013; Yuen, Herbert, Forman, Goetter, Comer, et al., 2013; Thorsell et al., 2011). Guidelines for psychological therapies also recognise computerised cognitive behavioural therapy (cCBT) as a recommended treatment option for various illnesses such as depression, panic, phobia, and obsessive compulsive disorder (NICE 2006; NICE 2009; SIGN 2010). This highlights that recent developments in delivering psychological therapies are considering the use of technology to increase their availability.

Furthermore, the use of technology is widespread within society. For example there were nearly 1.4 million app downloads in 2014 and this is estimated to rise to nearly 2.7 million by 2017 (Statista, 2015). Technology has been increasingly implemented in behavioural

healthcare and has shown promising results in terms of expanding the range of healthcare delivery (Luxton, McCann, Bush, Mishkind, & Reger, 2011). This rapid growth has raised concerns in terms of patient safety as many smartphone applications (apps) and internet sites are marketed without being thoroughly researched in terms of effectiveness or safety. Therefore it is paramount to trial the feasibility, effectiveness and safety of such interventions. Indeed, such research has been conducted on differing modalities of treatment. This is highlighted by a review of smartphone applications which found significant reductions in depression, stress and substance misuse, where the interventions ranged from cognitive therapy, behavioural activation to self-monitoring (Donker et al., 2013). The review indicated that although these interventions have the potential to be useful and increase treatment availability, currently they lack scientific evidence regarding their effectiveness.

There is some evidence for the effectiveness of these types of technology mediated interventions. For example, an internet delivered intervention has been found to have small effects for glycaemic control in adults with type 2 diabetes, with a larger effect for a subgroup who received the intervention via mobile phone app (Pal et al., 2013). Internet delivered CBT for pain has been found to have moderate effects (d=0.58) post intervention, compared to control (Cuijipers, Straten & Andersson, 2008). Furthermore, Hedman, Ljótsson, & Lindefors (2012) conducted a systematic review for internet delivered CBT considering randomised controlled trials and found large effect sizes in the treatment of depression, panic disorder, social phobia, post-traumatic stress disorder, generalised anxiety, specific phobia, chronic pain, irritable bowel syndrome, sexual dysfunction, eating disorders, and body dissatisfaction (range d=0.60-1.84). Single studies found large effect sizes for obsessive compulsive disorder d=1.55, and severe health anxiety d=1.94, and medium effect sizes were found for tinnitus d=0.51. This shows that CBT is effective when delivered via the internet and can produce similar effects to traditional delivery methods. Moreover, they analysed the cost-effectiveness of such delivery. Although data were scarce, it suggested that internet delivered CBT has more than 50% probability of being cost effective compared with no treatment or traditional CBT (Hedman, Ljótsson, & Lindefors, 2012). Although these studies highlight that such interventions are effective, currently most research has only considered the utility of using technology to deliver CBT.

One current development within CBT is the growth of Acceptance and Commitment Therapy (Twohig, 2012; Block-Lerner, Wulfert, & Moses, 2009). Like other therapies, a common problem faced in delivering Acceptance and Commitment Therapy (ACT) is one of volume.

Therefore mediums such as the internet or smartphone applications may pose a potential solution to delivering ACT and making it more accessible. As stated earlier, these theoretically driven interventions need to be evaluated scientifically to determine their effectiveness and ensure they are safe. ACT has been fully described in a number of other sources (Hayes, Strosahl, & Wilson 2012; Hayes, Luoma, Bond, Masuda, & Lillis, 2006; Hayes, Villatte, Levin, & Hildebrandt, 2011). Briefly, ACT is a form of CBT that is distinguished by its focus on 'psychological flexibility', the mechanism underlying this approach. This is to bring attention to current behaviour, such as bringing awareness to thoughts, and difficult internal personal experiences, aiming to live a life the patient would value without attempts at controlling or avoiding such distressing experiences. It has been described as the ability to be open, present-focused, and aware, and to change or persist in behaviour when doing so serves ones values and goals (Hayes et al., 1999). This is achieved by employing predominantly experiential treatment methods. These methods include exposure, metaphors and by creating a compassionate, respectful and psychologically active therapeutic relationship. Due to the emphasis on the nature of the therapeutic relationship and the enactive nature of the approach, it poses the question of whether ACT interventions will really work in the context of delivery without a therapist. To date there is no review which considers the effectiveness of ACT when delivered through different modalities such as through the internet or smartphone apps.

The aim of this review are to assess the acceptability and the effectiveness of ACT delivered by technology.

Methodology

Eligibility Criteria

This review placed no restrictions on the age, ethnicity or gender of participants. The interventions considered for this review had to be delivered through a form of technology such as the internet or smartphone. Studies with no or minimal therapeutic contact were included in this review. Minimal therapeutic contact were studies that used asynchronous contact, real-time data collection, assessment of eligibility, introduction to the study, debriefing or technical support. Studies were defined as 'pure self-help' and 'guided self-help'. 'Pure self-help' was defined as studies with no therapeutic contact. This group also contained studies which used minimal contact, for example interventions where participates received technological support, or that used a real-time therapist for data collection or introducing the study, assessing for eligibility, obtaining consent, debriefing participants or planning for the future after participants had completed the intervention. 'Guided self-help' was defined as studies which

used asynchronous clinical support from a trained therapist through technology (e.g. text-messaging, email, web portals) were included. Asynchronous support was defined as, having clinical support from a therapist which was not real-time. Real-time therapist interactions to deliver the intervention were an exclusion criteria, as this was deemed to be conceptually different to receiving therapy through an application or internet program. For example, if participants received face to face, real time contact with a therapist, mediated by technology (i.e. a therapy via Skype, telephone, or interactive messaging service) the studies were excluded from this review. Interventions had to be based on ACT. The use of technology had to be the main focus of the study and could not be used to enhance other techniques such as self-help books, individual or group therapy. All forms of trials were incorporated, including controlled and uncontrolled trials, as long as outcomes regarding the intervention were reported. Therefore, included studies could have been feasibility, longitudinal, pilot studies or randomised control trials (RCTs). Cross sectional studies, protocols for future studies, qualitative studies, reviews, commentaries, conference abstracts and editorials were excluded as these would not provide the data to adequately answer the review question. Poster presentations, were also excluded as the researchers wanted to restrict the evidence to that which was published in peer review journals, as they have been deemed to have had some independent scrutiny. Primary outcomes regarding the effectiveness on health were through objective or self-report measures. Secondary outcomes regarding acceptability of delivering ACT through various forms of technology were through self-report measures and technology usage which could have been qualitative or quantitative. Studies were included regardless of publication status, meaning studies could still be in press or unpublished studies submitted for review, and had to be written in English. Inclusion criteria table can be found in supplementary material (appendix 1).

Information Sources and Search

The search terms (digital computer/ computer/ (handheld* or hand-held* or hand held*)/ (personal digital assistan* or PDA*)/ (smartphone* or smart phone* or smart-phone*)/(blackberry* or black-berry* or black berry*)/mobile application/ or mobile phone/ Android*/window*/ HTC/ mobile phone/ or mobile application/telephone/ or mobile phone/ or cellular phone*/ samsung (iPhone* or iphone*)/ (iPad* or ipad*)/ computer program/ or mobile phone/ or computer/ or nokia/ or telephone/ Internet/ web (Acceptance and commitment therap*) were input into PsycInfo (1806-2014), Embase (1974-2014), OvidMedline (1946-2014), PsycArticles, YourJournals@Ovid, Journals@Ovidfulltext,scopus and Web of Knowledge. The search was run on 2nd February 2016. Applied Social Science

Index, Cumulative Index to Nursing and Allied Health Literature, International Bibliography of Social Science were also searched but no further articles were found. The website of the Association for Behavioural Contextual Science (ABCS: www.contextualscience.org) was searched for relevant studies, and the first author contacted a special interest group for ACT and technology within ABCS, informing the group of this review to establish whether any unpublished trials could be included.

Study Selection

Each database was searched separately, duplicates were removed once combined. Titles and abstracts were read to determine relevance using the inclusion criteria. Included studies had to use an ACT intervention delivered via technology and to report on effectiveness. Studies could not use these interventions as an adjunct to self-help books or face-to-face therapy. The inclusion criteria is described in more detail in Barker & Gillanders (2015) protocol, which was pre-registered on PROSPERO (http://www.crd.york.ac.uk/PROSPERO/search.asp; CRD42015020419). Of the abstracts which appeared to meet inclusion criteria, full articles were read to determine whether they could be included in the review. From the eligible papers, references were manually scanned, and abstracts read where the references were considered relevant. Full articles of relevant abstracts were read by two independent researchers (EB & KR) to determine whether they were included or not. Where there was any uncertainty a conversation was had to determine whether the article should be included and a third researcher was used (DG). Additionally, the first author (EB) contacted authors of two papers to establish whether therapist contact was asynchronous. One author did not respond and the study stated that feedback to participants was provided within a time frame e.g. 24-48 hours then it was assumed there was at least a 24 hour delay in the contact, and therefore asynchronous.

Data collection process

A data extraction table was used to obtain information on demographics of participants, study design, use of technology, intervention components, sample size, information on comparator groups if used, allocation concealment and blinding of outcome appraisers, duration of intervention and outcomes, application of ACT processes, and additional therapeutic input or contact. Additional therapeutic contact was defined as 'guided self-help', minimal contact, or no contact. 'Guided self-help' was asynchronous clinical contact (described above). Minimal contact included where real-time contact was used for initial contact for consent and assessment, or final contact after participants had completed the intervention to debrief or for

data collection. No contact included where there was no clinical contact from a professional or where there was only automatic responses from the intervention itself. Data extraction was undertaken by the first author (EB).

Quality Criteria

The quality criteria used in this review were adapted from the Cochrane guidelines (Higgins, Green, & Cochrane Collaboration, 2008) which includes allocation concealment, blinding, incomplete data, selective outcome reporting and other biases. It was altered by the first author (EB) and appraised by the research team to meet the aims of this review. Items are rated as well covered (3), adequately covered (2), poorly covered (1), not stated (0) or not applicable (0). Each study generates a score from 0-39, with the higher score indicating greater methodological rigor according to the aims of this review. One of the criteria of note for this review is 'therapist contact'. 'Guided self-help' was deemed poorly covered, minimal contact was deemed adequate, and no contact was deemed well covered. This is because asynchronous contact undermines the pure technology aspect and delivers a human angle. It was considered that there was something fundamentally different about participant's knowing that a trained therapist is watching their progress, giving feedback, posting messages, or deciding whether they should progress etc. Therefore, although these do not lead to a poorer quality intervention, it is less purely operationalised as ACT delivered by technology, and is deemed as poorer quality to address the aims of this review. Other criteria can be reviewed in the supplementary material (appendix 2). The second researcher (KR) assessed 50% of the studies according to the criteria and where there were discrepancies, a conversation established a consensus.

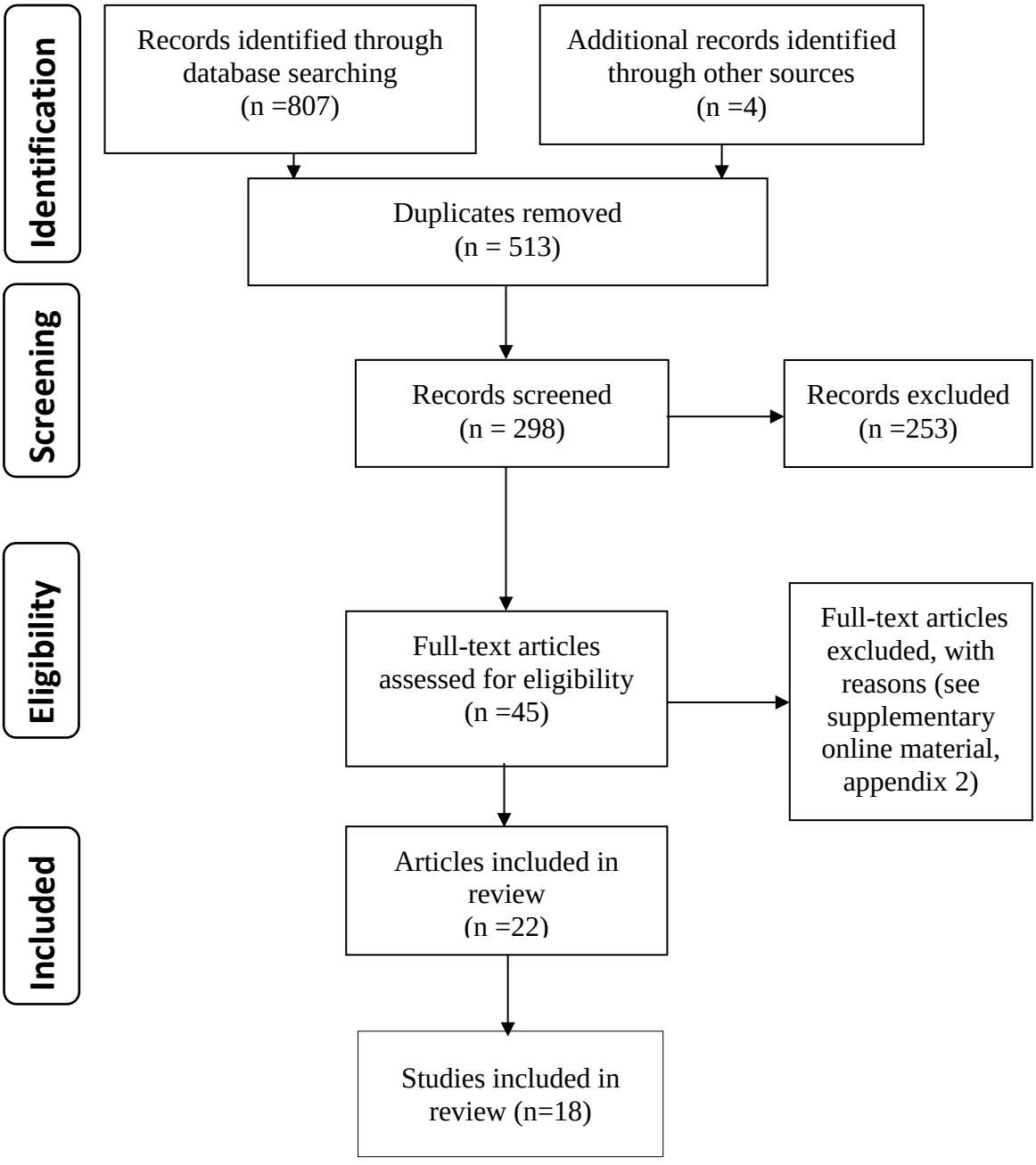
Results

Study Selection

The search criteria run on the 2nd February 2016 yielded 807 articles with an additional four from other sources, of which 513 were duplicates. Titles and abstracts of the remaining 298 articles were reviewed using a PICOS table and the inclusion criteria applied, as described above. Of the 298 articles, 253 were excluded due to the titles or abstracts not being relevant to the review question, leaving 45 articles to be read in full. Two independent researchers (EB and KR) reviewed these studies and agreed on excluding a further 23 articles, leaving 22 articles which related to 18 studies to be included in this review (see figure 1 for Prisma flow diagram). The main reasons for exclusion due to them being protocols, using a real-time

therapist or the technology was used in conjunction with another form of face-to-face therapy, and the studies did not report on effectiveness.

Figure 1. PRISMA Flow Diagram of included studies in review



Study Characteristics

Sample Characteristics

Depression (n=4) and stress (n=3) were the most commonly investigated conditions. Other studies investigated: smoking cessation, chronic pain, undergraduate college performance, valued living, tinnitus anxiety, fibromyalgia, bipolar depression, diabetes, generalised anxiety and perfectionism. Sample sizes ranged from 11 to 300. Generally studies tended to have more females than males. Five studies had relatively fewer females which ranged from 33.3%-43.4%). One study had 100% female participants (Ljotsson et al., 2013). The age of participants ranged from 18 to 60 years, with a mean age between 40 and 50 years. The majority of participants were Caucasian.

Study Duration

The shortest intervention period was 3 weeks (Murray et al., 2015; Levin., 2013; Levin et al., 2014; Levin et al., 2013), with the longest being 12 weeks (Bricker et al., 2013; Jones et al., 2013; Nes et al., 2012; Pots et al., 2015 ; Trompetter et al., 2014) . One study did not state the study duration but number of completers of the intervention (Newton, 2013). Eight of the studies had a follow-up, the longest being 18 months (Lappalainen et al., 2014), and the shortest being 6 weeks.

Type of Intervention

Thirteen of the studies used an internet only intervention (72%). Three used a smartphone app only (Ahtinen et al., 2013; Bricker et al., 2014; Ly, Asplund, & Andersson., 2014). The remaining two used both internet and smartphone. One of these studies used web-based diaries with situational feedback via smartphone app (Nes et al., 2012), and the other used smartphone app with web-based psychoeducation (Ly et al., 2012). See table 1 for more detail of the study characteristics.

Table 1. Study Characteristics

Reference	Focus of study	Sample size (per group)	% Female	Age M (SD)	Study Duration with measurement time points	Study Design
1.Ahtinen et al (2013) Finland	Stress	15	60%	5 were younger than 30, 5 between 31 & 40 and 5 were older than 40.	4 weeks: baseline, mid (1 week), post (1 month)	Pilot
2.Bricker et al 2013 USA	Smoking	222 (111)	39% ACT group: 65% comparison group	44.8 (13.6) ACT: 45.3 (13.1) comparison	4 weeks: baseline, mid (1 week), post (1 month)	RCT
Jones et al 2013 USA	Smokers with depression	94 of the 222 (47)	51% ACT group: 57% comparison	43.6(14.5) ACT: 43.2 (12.2) comparison		
3.Bricker et al (2014) USA	Smoking	196 (98)	53% ACT group: 51% Comparison group	41.5 (12) ACT: 41.6 (13.9) comparison	8 weeks: baseline and post (8 weeks)	RCT
4.Buhrman et al (2013) Sweden	Chronic pain	76 (38 - 3 declined treatment meaning 35)	59.2%	49.1 (10.34)	7 weeks: baseline, post (7 weeks), FU (6 month)	RCT
5.Carlbring et al (2013) Sweden	Depression	80 (40)	82.5%	44.4 (13.5)	7 weeks: baseline, post (7 weeks), FU (3 month)	RCT
6.Chase et al (2013) USA	Undergraduate college performance	132 (51 ACT: 48 comparison: 33 WL)	78%	78% between 19-22, range 18-25	4 weeks: baseline, post (1 month), FU (approx. 6 months - spring to fall)	RCT
7. Dahlin et al (2016) Sweden	GAD	103 (52 ACT: 51WL)	83.5%	39.48 (10.73)	9 weeks: baseline, post (9 week), FU 6 month	RCT
8.Hesser et al (2012) Sweden Hesser Westin, & Andersson (2014) Sweden	Tinnitus	99 (32 CBT: 35 ACT: 32 control)	43.4%	48.5 (14.7)	8 weeks: baseline (2 weeks prior to treatment), mid (3 weeks), post (8 weeks), FU (1 year - for 2012 study only).	RCT

Reference	Focus of study	Sample size (per group)	% Female	Age M (SD)	Study Duration with measurement time points	Study Design
9.Lappalainen et al (2014) Finland	Depression	38 (19 each group)	68.4%	44.61 (14.28)	6 weeks: baseline, post (6 weeks), First FU (6 month), Second FU (18 month)	RCT
10. Levin, (2013) USA. **Levin et al (2016) USA** **Levin et al (2014) USA**	Stress, depression, anxiety	234 (114 ACT: 120 comparison) 234 (110 ACT: 118 comparison) 76 (37 ACT: 39 WL)	76.9% 53.9%	Mdn 20 years (M=21.61, SD=5.48, Range=18 – 58). 18.37 (0.54)	3 weeks: baseline, post (3 weeks), First FU (6 weeks), Second FU (3 months) 3 weeks: baseline, post (3 weeks), FU (6 weeks)	RCT
11.Ljotsson et al (2013) Sweden	Fibromyalgia	41	100%	52 (9)	10 weeks: baseline, post (10 weeks), FU (6 months).	Pilot
12.Ly et al (2012) Sweden	Valued living	11	36.4%	29.5 (5.96)	4 weeks: baseline, post (4 weeks)	Pilot
13.Ly et al (2014) Sweden	Stress	74 – one did not begin = 73 randomised (36 ACT: 37 WL)	42.5%	41.5 (7.2)	6 weeks: baseline, post (6 weeks)	RCT
14. Murray et al (2015) Australia	Bipolar	26	75% (n=10 not collected due to technical error)	46.6 (12.9)	3 weeks: baseline, post (3 weeks)	Pilot
15.Nes et al (2012) Norway	Diabetes	15	33.3%	59.6	12 weeks: baseline, post (3 month)	Pilot
16.Newton (2013) USA	Perfectionism	300	35.5%	31.16 (8.956)	Doesn't state time period for analysis but number of completers of 30 steps	Pilot

Reference	Focus of study	Sample size (per group)	% Female	Age M (SD)	Study Duration with measurement time points	Study Design
17. Potts et al (2015) Netherlands	Depression	236 (82 ACT: 67 EW: 87 WL)	Total =75.8% (92.7% ACT, 59.7% EW, 72.4% WL)	Total 46.85 (12.06), ACT 45.15 (10.78), EW 46.73 (12.65), WL 48.54 (12.63)	12 weeks: baseline, post (3 months), FU1 (6 months), FU2 (12 months)	RCT
18.Trompetter et al (2014) Netherlands	Chronic pain	238 (82 ACT: 79 EW: 77 WL)	76.8% ACT group: 75.9% EW group: 75.3% WL	ACT 52.9 (13.3), EW 52.3(11.8), WL 53.2 (12.0)	12 weeks: baseline, post (3 months), FU (6 months)	RCT

Note: FU, follow-up; Approx, approximately; ACT, acceptance and commitment therapy; EW, expressive writing; WL, waitlist; M, mean; SD, standard deviation; Mdn, median; RCT, randomised control trial; when two articles present data on the same study they are shaded together.

Study Design

Twelve (66.7%) of the studies were randomised trials using control or comparison groups. Three used waitlist only as a comparator, one used online discussion forum as a comparator, two used another internet intervention, one used another smartphone app intervention, four used an active control and waitlist, and one used another internet intervention and an online discussion forum. Of the 12 randomised trials four concealed group allocation to participants (Bricker at al., 2013; Bricker et al., 2014; Jones et al., 2015; Chase et al., 2013; Pots et al., 2016). Three of these concealed group allocation to the researchers conducting the analysis (Bricker at al., 2013; Bricker et al., 2014; Jones et al., 2015; Chase et al., 2013). The remaining six studies were within-group designs. See table 2 for more details on therapeutic components.

Table 2. Intervention Components

Reference	Focus of study	Delivery platform	Intervention	Comparison elements
1. Ahtinen et al (2013) Finland	Stress	Mobile App	4 modules: aware mind, wise mind, values, health body. The first 3 modules teach the user the 6 core processes of ACT (*Aware mind*= awareness of present moment. *Wise mind*= *A*cceptance. *Values*=clarifies personal values and committed action). The 4th module focuses on physical wellness (*Healthy body*=relaxation, mindfulness). Consist of 46 text and audio exercises. Each module included 1-4 subsections, which include 5-8 exercises. Intro text and video is included in each module and informs the user about process and skills taught in them.	N/A
2.Bricker et al (2013) USA **Jones et al (2015) USA**	Smoking Smokers with depression	Internet	8-part self-paced programme centred on the metaphor of a car journey with the participant being the driver heading in direction which matters to them taking the passengers with them. Part 1: values with videos of former smokers saying how quitting changed their lives in fundamental ways. Part 2: committed action, making quit plan based on values. Part 3-7: acceptance, being present, self as context, former smokers modelled experiential exercises and metaphors. Part 8: review progress	smokefree.gov involves quit planning, skills training, advice on pharmacotherapy and social support for quitting

Reference	Focus of study	Delivery platform	Intervention	Comparison elements
3.Bricker et al (2014) USA	Smoking	Mobile App	8 identical weekly email reminders were sent to prompt use of self-paced app. 5 features: 1: *staying motivated* ACT values-based motivations to quit via testimonials of former smokers and photos uploaded by user to show why they are stopping, 2: *my quit plan* develop personalised quit plan. Identifying social support for quitting provides info on selecting FDA approved meds for quitting. Naming values guiding quitting and uploading photos to symbolise that value, 3: *having an urge* audio and text acceptance skills, 4: "*I slipped"* skills of self-compassion for recovering from lapses and self-judgement that often accompany them, 5: *Tracking* record number of times they have allowed an urge to pass without smoking. Number of times they practiced an exercise. Self-monitoring of each cigarette smoked and use of meds to aid cessation.	8 identical weekly email reminders were sent to prompt use of app. National Cancer institute's QuitGuide was comparator. It has features: *thinking about quitting* focuses on reason-based motivation to quit by encouraging users to list reasons and providing info on health consequences of smoking and quitting. *Preparing to quit* helps users develop a personalised quit plan identifying social support for quitting, provides info on selecting FDA approved meds for quitting. *Quitting* teaches skills to avoid cravings, such as finding replacement behaviours. *Staying Quit* presents skills for coping with slips via fighting cravings and trying to be positive.
4.Buhrman et al (2013) Sweden	Chronic pain	Internet	Programme comprised of 7 sections based on ACT. Most exercises mp3 downloads. Information, assignments, metaphors, and mindfulness. 1: creative hopelessness: Participants asked to register previous strategies to manage pain and reflect on short term & long term effects of their efforts. 2: willingness & acceptance: Physiological and psychological consequences of pain distinguished & assignment about willingness in contrast to control strategies. 3: defusion exercises & participants asked to formulate goals. 4&5: committed action & values. 6: willingness in accordance with their values. 7: maintenance: Learnt strategies and evaluation of programme. In order to access next content participants had to send assignments to therapist.	Control group participated in an online discussion forum where weekly discussion topics were presented and discussion encouraged. Discussions were of general character "how is chronic pain represented in the media". After 7 weeks all participants were prompted to log on to the study website to complete outcome measures. Those who did not login received a text message.

Reference	Focus of study	Delivery platform	Intervention	Comparison elements
5.Carlbring et al (2013) Sweden	Depression	Internet	Treatment material commercially available called depressionshjalpen. Programme has focus on behavioural activation with influences from ACT (defusion, acceptance and mindfulness, and values). Consisted of 7 modules: 1. psychoeducation about depression, 2. link between activity and well-being, 3. understanding different activities and the role of reinforcement, 4. make a difference in your life, 5. thoughts and emotions, 6. repetition and continued practice, and 7. relapse prevention.	Wait-list control
6.Chase et al (2013) USA	Undergrad college performance	Internet	Goals & values programme: exposed to academic values programme: defines values from an ACT perspective, guides participant's identification of their values using both positive and negative examples, with an emphasis on the distinction between values & goals based on ACT concepts, reflection on academic goals and what is important to them as a person. After the values programme, participant's received the same as the goal setting programme, allowing goal setting to be informed by values.	Goal setting programme: provided info about importance of academic goal setting and how to set challenging goals that were specific, measureable, attainable, realistic and time-orientated (SMART). Content provided via media clips with embedded text that corresponded with audio files. Participants asked questions following each segment of info and feedback provided. After learning how to set goals, participants prompted to set a long term goal (next 2-3 years or after graduation), intermediate goal (end of semester) and short term SMART goals to meet these, list obstacles and generate possible solutions, why the goal was important, potential benefits of achieving the goal, and to list specific action steps needed to achieve goal. Waitlist which received goals & values group 1 semester later

Reference	Focus of study	Delivery platform	Intervention	Comparison elements
7. Dahlin et al (2016) Sweden	GAD	Internet	Commercially available programme "Oroshjalpen" (the worry help). 7 Modules: 1. What is worry? Psycho-education on anxiety and worry 2. Functional analysis presented and encouraged to practice with own behaviours. 3. Values based activities. 4. To be mindful and present. 5. Worry as a process, and struggles with this. Participants asked to take a different stance. 6. Acceptance. 7. What works best for you? Review treatment and think about future self-directed treatment. All containing mindfulness, acceptance and valued action with text, audio, animation and video	Wait-list control
8.Hesser et al (2012) Sweden **Hesser Westin, & Andersson (2014) Sweden**	Tinnitus	Internet	Included mindfulness audio files, psychological exercises for defusion, values & goals, willingness to experience tinnitus in the context of value-based behaviour change.	iCBT: Used applied relaxation, positive imagery, attention training, cognitive restructuring, exposure, use of background sounds to cope with the experience of tinnitus. Confidential moderated discussion forum that specifically targeted tinnitus problems. Therapist monitored discussion and posted new topic for discussion weekly.
9. Lappalainen et al (2014, a) Finland	Depression	Internet	Participants were guided to use 'good life compass'. Therapist developed a functional analysis clinical case model. Consists of 6 modules, each week's module allocated to one of the processes. Creative hopelessness & values, value-based action, contact with the present moment, cognitive defusion, self as context and acceptance. Consists of text, pictures, audio-based self-help materials, weekly self-help text and experiential exercises.	Session 1 same as iACT. Session 2: presenting Functional Analytic Clinical Case Model (a vector-graphic approach to functional analysis, value analysis based on participants value description followed by experiential exercises. Sessions 3, 4 &5 were personally tailored based on ACT book for therapists, Session 6: experiences and observations discussed, individual plan for future including values-based action were made.

Reference	Focus of study	Delivery platform	Intervention	Comparison elements
10. Levin (2013) USA **Levin et al (2016) USA** **Levin et al (2014) USA**	Stress, depression, anxiety	Internet	ACT-CL consisted of 2 web-based multi-media lessons. Lesson 1: values clarification and goal setting, lesson 2: acceptance and committed action. Participants were required to wait one week after completing the first lesson before starting the second. Supplementary materials: 1. Follow up emails through the ACT program to complete one's goals and suggestions for additional ways to work with values and willingness. 2. Emailed link to mindfulness which were primarily text based with some supplementary illustrations and downloadable audio guided exercises (introduction to mindfulness and guiding practice a breathing meditation, and learning how to notice difficult internal experiences for what they are without fighting with or getting entangled in them). There was an introduction to the concept of "observing passengers for what they are", written instructions for practicing a labelling mindfulness exercise, and additional downloadable exercises to continue practicing mindfulness. A text messaging feature was included and participants were asked whether they would like to receive text messages as part of the program	"Healthy Living" involved two web-based lessons focused on providing basic educational information about the symptoms and causes of depression and anxiety as well as brief information on coping strategies. Primarily text-based, but also included supplementary illustrations and knowledge test questions. Lesson 1: Depression (overview and introduction to the program, psychoeducation on prevalence and causes, planning daily activities seeking support from others, relaxation, coping with depression in a relationship). After one week they were emailed a link to the second lesson. Lesson 2: Anxiety and stress. (overview and introduction, psychoeducation on symptoms and causes of stress, prevalence and causes for different anxiety problems, encouraging physical activity, goal setting, time management, positive thinking, planning activity, socialising, relaxation, taking time for self, and communication) as well as tips for more specific problem areas including struggling with concentration, confidence, and test anxiety. Mental Health Education: 3-week program. 2 web-based sessions: basic educational information on symptoms and causes of depression and Anxiety. Brief information on coping strategies. Aimed to match ACT-CL number of pages and amount of content. Waitlist - waiting for three weeks to be provided with intervention.

Reference	Focus of study	Delivery platform	Intervention	Comparison elements
11. Ljotsson et al (2013) Sweden	Fibromyalgia	Internet	Treatment manual based on iCBT for IBS and an ACT manual for face-to-face group treatment of FM. There were 5 successive steps. 1: Introduction and information on fibromyalgia and pain. 2: Exploring avoidance. 3: Mindfulness and Acceptance. 4: values. 5: Relapse prevention. Participants had to report they had worked through a treatment step to gain access to the next step. They were encourages to work through steps 1-4 during the first half of treatment. After the 4th step participants would send weekly reports about their work with exposure exercises. Participants also had access to online closed discussion forum where they could discuss their treatment with each other.	N/A
12. Ly et al (2012) Sweden	Valued living	Internet & Mobile App	Psychoeducation was presented on the web and could be viewed on the phone. It was presented in 4 modules which lasted approximately 45 minutes. Module 1: introduction to study, 2: how to use values as a tool for behavioural activation, 3: finding your values, 4: how to install and use the app. The app looked at behaviour frequency in relation to life domains.	N/A
13. Ly et al (2014) Sweden	Stress	Mobile App	6 week education behaviour programme. 6 module:, 1 each week. Each module had audio lecture 4-6 minutes, 2-3 texts, 2-4 exercises. Recommended to spend 15 minutes a day on the programme. When an exercise was completed participants registered and wrote a short reflection and evaluate their experience. Could access personal stats and summaries of activity. All data accessible for therapist online.	Waitlist control

Reference	Focus of study	Delivery platform	Intervention	Comparison elements
14. Murray et al (2015) Australia	Bipolar	Internet	Emotion regulation (defusion techniques), relationship to self (self as observer and committed action), sleep quality (mindfulness and acceptance). These were structured into 4 modules. 1: Introduction, 2: Self-Acceptance, 3: Mindfulness, 4: Values & Goals.	N/A
15. Nes et al (2012) Norway	Diabetes	Internet & Mobile App	Individualised situational feedback, mindfulness & relaxation audio files, and a healthcare tool the FewTouchApplication. Provided with notebook with written exercises identifying values. Completed online diaries.	N/A
16. Newton (2013) USA	Perfection	Internet	Module 1: Perfectionism/Values Exploration. Differing types of perfectionism were explained they were provided with their scores in relation to: Self-Oriented, Other-Oriented and Socially Prescribed Perfectionism. Concept of values explained to them. Module 2: Cognitive interventions (alternative thoughts using thinking errors). Module 3: Acceptance/Follow-Up Focused the thoughts which still remained (alternative thoughts not thought of/believed) using concepts of acceptance and commitment (illustrated though distancing oneself from ones thoughts, basic mindfulness techniques, and validation of thoughts and committing to valued action despite them).	N/A

Reference	Focus of study	Delivery platform	Intervention	Comparison elements
17. Pots et al (2015) Netherlands	Depression	Internet	Based on 'living life to the full' with 9 modules divided into three parts based on the six core processes of ACT. 1st part: reflections on avoidance and control strategies, 2nd part taught how to stay present without trying to control or avoid experiences, third part awareness of values. Additional focus on relapse prevention, self-management and action plans. Encouraged to practice daily mindfulness. Wrote to councillor after completing each session	Expressive writing (EW) = internet based matching the number of ACT sessions. Sessions started with psychoeducation on emotions and emotion regulation. Asked to write about emotional experiences for 15-30 minutes at least 3 times per week. First three sessions focused on negative experiences, session 4-6 participants reviewed their experiences and focused on emotion regulation and reappraisal of emotions. Session 6-9 positive experiences and self-management. Wrote to councillor after completing each session Wait-list control
18. Trompetter et al (2014) Netherlands	Chronic pain	Internet	"Living with pain" was the internet intervention. Based on self-help programme 'living to the full' and the protocol 'living with your pain'. 9 modules which could be worked through in 9-12 weeks. Each used text experiential exercises and metaphors for illustrating the 6 processes of ACT. Participants downloaded mindfulness exercises which lasted 10-15 minutes and were encouraged to practice mindfulness daily. Participants could read experiences of previous ACT participants and keep a personal diary. Approximate time investment asked was >=3 hours per week	EW = internet based, invited to write, or rather emotionally disclose, about highly stressful experience usually in multiple sessions. 9 modules which would be worked through in 9-12 weeks. Each module started with psychoeducation about emotions and emotion regulation related to the pain experience followed by specific writing assignment. Participants advised to write at least 3 times a week for approximately 15 minutes. An online personal diary was included in the intervention. Approximate time investment asked was >= 2 hours per week Wait-list control – participants were free to access other forms of treatment. After 6 months participants could follow ACT treatment without counselling.

Note: ACT, acceptance and commitment therapy; CBT, cognitive behavioural therapy; iACT, internet acceptance and commitment therapy; iCBT, internet cognitive behavioural therapy; EW, expressive writing; ACT-CL, acceptance and commitment therapy on college life; FM, fibromyalgia; GAD, generalised anxiety disorder; IBS, irritable bowel syndrome; cont., continued; N/A, not applicable; FDA, food and drug administration; when two articles present data on the same study they are shaded together.

Therapist Contact

Six of the studies used no additional therapist contact (33.3%). Ten studies contained asynchronous feedback (55.6%). The remaining studies either provided technological support or had initial or final meeting to introduce the study and to collect data.

Therapist Fidelity

Information on the supervision and training of therapists providing feedback was only included in some studies, therefore the first author contacted the authors of the studies to determine the fidelity of this contact being in-line with ACT. Of the 12 studies which used some form of clinical contact, 10 included training of therapists and/or supervision from an experienced ACT therapist (83.3%). The remaining two did not specify whether the supervisor was experienced in ACT. See table three for more information on additional therapeutic contact and fidelity.

Table 3. Therapeutic Contact

Reference	Additional therapeutic contact	Therapist characteristics Training or supervision provision
1. Ahtinen et al (2013) Finland	Face-to-face group consisting of two 10 minute presentations, one on ACT in general and one on the specific intervention, aims and process of study explained and phone provided. User guide provided on paper.	Trained therapist with prior experience in ACT.
2.Bricker et al (2013) USA **Jones et al (2015) USA**	No	N/A
3.Bricker et al (2014) USA	phone call to confirm study interest	N/A
4.Buhrman et al (2013) Sweden	Correspondence held through web portal. Participants instructed to send their assignments to therapist who sent feedback within 24 hours during weekdays. Received 2 phone calls; when completed section 3 and 7 weeks into treatment - aimed to motivate and encourage.	Therapists were graduate students in last term of 5 year clinical psychology programme. They received weekly supervision from clinical psychologist every week.
5.Carlbring et al (2013) Sweden	Initial interview. Participants encouraged to message therapist weekly. Therapists feedback mainly focused on validating participant's experience reinforce progress & encourage continuing working with treatment.	Therapists were MSc students who received weekly supervision with licensed psychologist.
6.Chase et al (2013) USA	No	N/A
7. Dahlin et al (2016) Sweden	Diagnostic interviews. Weekly asynchronous support was given	Clinical psychologist graduate students who were supervised weekly by a licensed psychologist who had been active in the development of the treatment program
8.Hesser et al (2012) Sweden **Hesser Westin, & Andersson (2014) Sweden**	Phone interview assessing suitability. Enrolment meeting to review assessment data. Therapist could post messages on a secure encrypted web-page. Feedback provided from homework tasks and therapists determined whether participant was ready to proceed to the next module.	1 licensed clinical psychologist, 6 clinical psychology MSc graduates. Six had previous experience with ACT, one had limited ACT experience. Six involved in adapting the treatment protocols. Weekly supervision by supervisors who had developed the original protocols and experiencing in providing either CBT or ACT for tinnitus. Supervisors monitored therapist throughout treatment by checking the correspondence between therapist and participant.

Reference	Additional therapeutic contact	Therapist characteristics Training or supervision provision
9. Lappalainen et al (2014) Finland	Face-to-face appointment initially and at 6 weeks to gather information on current situation, concerns and relevant history. Participants guided to use 'good life compass'. After 6 week intervention completion: individual plan for future including values-based action were made. Weekly feedback where therapists instructed the suggested possible additional exercises or metaphors appropriate for progress.	MSc students in Psychology. 18 therapists. Received 13 hours training in ACT, included lectures on general principles and presentations & practice of functional analytic clinical case model, had to read Finnish version of ACT-book Get out of your mind and into your life (Hayes & Smith, 2005). Weekly group supervision 18hrs (6 weeks* 3 hours). Supervisor had 30 years clinical experience, supervision and 12 years ACT experience in clinical setting. Therapists required keeping record diary to monitor adherence to protocol, and report methods used in therapy which were reviewed by a supervisor
10. Levin, (2013) USA **Levin et al (2016) USA** **Levin et al (2014) USA**	A survey was sent out 1 month and 3 months post intervention. Reminder emails and phone calls were made every 3 to 6 days to complete the survey for 21 days or until the survey was complete. Tailored email after each lesson checking the goal the participant had set and after lesson 1 suggesting additional exercises to work with one's values, after lesson 2 methods for practicing willingness. After lesson 1 an automated email informed participants that the next lesson was available	Therapist trained in ACT and received supervision from an experienced ACT therapist
11. Ljotsson et al (2013) Sweden	Initiated by the participants, who were encouraged to send at least one message per week re: work with their treatment.	Two graduate psychology students who had received lectures about ACT as part of their psychologist education. Supervision was conducted by a clinical psychologist with some training in ACT and they received one supervision session with an expert in ACT.
12. Ly et al (2012) Sweden	No	N/A
13. Ly et al (2014) Sweden	Therapist could message via SMS. Messages of encouragement were sent every other day and functioned as a one way communication system.	Final semester student from 5 year MSc clinical psychology programme. Completed clinical training as well as 16 week of practice. Therapist on average devoted 3 hours per week to providing feedback and group feedback to participants in intervention group.

Reference	Additional therapeutic contact	Therapist characteristics Training or supervision provision
14. Murray et al (2015) Australia	Technical Support provided but no clinical support	N/A
15. Nes et al (2012) Norway	Individual meeting between participant and researcher. Instruction manual provided to use the phone. Tailored written situational feedback via phone based on ACT focusing on values. Phone contact by researcher before beginning of intervention. Online diaries. Interviews mid-way and end of treatment regarding perception and evaluation of intervention.	Nurse specialist with clinical experience. Supervisor involved in providing feedback to participants was an experiences ACT therapist.
16. Newton (2013) USA	No	N/A
17. Pots et al (2015) Netherlands	Intervention groups wrote to counsellor after completing each session reflecting on the process and were able to ask questions. Participants could only proceed to the next session after receiving personalised feedback from their counsellor	Masters psychology students who attended a 2 day workshop. Each counsellor provided feedback to 25-30 participants. Supervised by clinical psychologists with ample experience in ACT, CBT and EW
18. Trompetter et al (2014) Netherlands	Counsellors provided email support. After completing weekly module participants sent message to counsellor reflecting on the progress made during the previous week. Participants could ask questions on texts and exercises. Counsellors provided structured response at a fixed day of the week aiming to compliment, reinforce, answer questions, explain unclear aspects, present next week's assignment, provide positive reinforcement to motivate participant to continue.	Trained and supervised by a registered cognitive behavioural therapist with ample experience with ACT and EW. Training included: Receiving info on chronic pain, studied both internet intervention programmes, performed exercises included in both manuals and practised writing emails.

Note: ACT, acceptance and commitment therapy; CBT, cognitive behavioural therapy; EW, expressive writing; N/A, not applicable; MSc, maters of science; when two articles present data on the same study they are shaded together.

Effectiveness

It is highlighted that effect sizes should be reported regardless of significance (Durlak, 2009). Effect sizes were calculated by the first author where they were not reported in studies using formulas from Dunst, Hamby & Trivette (2004). Where *z* scores were reported a formula from the University of Alabama (http://www.soph.uab.edu/Statgenetics/People/MBeasley/Courses/EffectSizeConversion.pdf. Conversion of Common Test Statistics to r and d Values, accessed 26th June 2015). Where correlations were not reported, test-retest reliability of the measure was used as a conservative estimate. Where odds ratio were reported, a formula from Borenstein, Hedges, Higgins and Rothstein (2009) was used to convert the values into Cohen's *d*. Where Hedge's *g* was used it was interpreted in the same way as Cohen's *d* as has been previously suggested (Hofmann, Sawyer, Witt, & Oh, 2010). It is also said to be a less biased estimate of effect size in smaller samples (Lakens, 2013). Studies were also tested to see if they met power to determine the reliability of the effect sizes found. This was calculated using g*power (Faul, Erdfelder, Lang, & Buchner, 2007). The primary outcome was the effect used to determine whether the study was adequately powered. This was seen as a pragmatic decision, as the minimum standard should be whether the sample is adequate to be able to detect the primary effect. Where two primary outcomes were measured, the smallest effect was used to determine the power of the study. This was as it was seen to be more conservative. Where the study were repeated measures between-within group design, the smallest effect on the primary outcome was used. This was for the same reason described above.

The largest between group effect on primary outcome was *d*=1.68. This showed higher 30-day quit rate in the intervention group compared to another computerised intervention, in a smoking cessation trial at 3 month follow-up (Bricker et al., 2013). The smallest between group effect on primary outcome was *d*=0.01 (Levin et al., 2016). However this study was underpowered so the likelihood of finding a true effect was reduced. This showed that stress at post intervention were lower in the intervention group compared to the control group. The largest within group effect on primary outcome was *d*=3.91. This showed a reduction in generalised anxiety at 6-month follow-up (Dahlin et al., 2016). The smallest effect was *d*=0.02. This showed that post intervention participants showed lower levels of stress (Levin et al., 2016).

There were four studies which used no additional contact (Bricker et al., 2013; Chase et al., 2013; Jones et al., 2015; Ly et al., 2012; Newton., 2013). These were grouped together with

three studies with minimal contact e.g. recruitment, data gathering (Ahtinen et al., 2013; Bricker et al., 2014; Lappalainen et al., 2014), and one which provided technical support (Murray et al., 2015). These 8 studies were considered 'pure self-help'. Four of these studies indicated a large effect on primary outcome at one time point (Ahtinen et al., 2103; Bricker al., 2013; Bricker et al., 2014; Newton., 2013). Three were sufficiently powered (Ahtinen et al., 2103; Birkcer et al., 2013; Bricker et al., 2014). Three highlighted medium effects at one time point (Chase et al., 2013; Murray et al., 2015; Lappalainen et al., 2014). Only Chase et al (2013) was sufficiently powered. One did not state the primary outcome measure but found small-medium effects and was underpowered (Newton., 2013). From the studies which were grouped as 'guided self-help', five studies showed large effects for primary outcome at one time point (Buhrman et al., 2013; Carlbring et al.,2013; Dahlin et al., 2016; Levin et al., 2014; Ljotsson et al., 2013). Two were sufficiently powered (Carlbring et al., 2013; Dahlin et al., 2016). Three showed medium effects at one time point (Hesser et al., 2012; Hesser, Westin & Andersson., 2014; Pots et al., 2015; Trompetter et al., 2014). Two were sufficiently powered (Hesser et al., 2012; Hesser, Westin & Andersson., 2014; Trompetter et al., 2014). One highlighted small effect at one time point (Levin., 2013; Levin et al., 2016; Ly et al., 2014). One study did not find an effect (Nes et al., 2012).

Cost Analysis

Only one study completed cost analysis (Ljotsson et al., 2013) and it was found that of the 36 people, who completed the intervention, there were significant cost reductions at post *d*=1.05 and at follow-up *d*=0.70 compared to pre-treatment. There were significant reductions from pre to post in medications (*d=0.74)*, direct non-medical costs (*d*=1.33), sick leave, unemployment, and reduced capacity at work (*d*=0.65), domestic loss (*d*=1.14). Additionally, there were significant reductions from pre to follow-up in health care visits (*d*=0.69) and domestic loss (*d*=1.08). They also found that costs were reduced by $26.52 for every point decrease in the main outcome (Fibromyalgia Impact Questionnaire) from pre-treatment. The average cost reduction at post treatment was $451 per month. The average treatment cost was estimated to be $818 per year, yielding equilibrium at about two months.

Applicability

This looked at whether participants were able to apply ACT principles to daily living. Eleven studies found either medium effects on process measures or that the qualitative reports of participants stated that that participants were applying ACT techniques to their daily lives, or made them more aware of valued action and barriers which get in the way of living a value consistent life. Five studies found large effects on process measures at one time point

(Buhrman et al., 2013; Hesser et al., 2012; Hesser, Westin & Andersson., 2014; Levin., 2013; Levin et al., 2014; Levin et al., 2016; Ljotsson et al 2013; Ly et al., 2012). Only one was sufficiently powered (Hesser et al., 2012; Hesser, Westin & Andersson., 2014). Five studies found medium effects on process at one time point (Jones et al., 2013; Lappalainen et al., 2014; Newton., 2013; Potset al., 2013; Trompetter et al., 2014). Two were sufficiently powered (Jones et al., 2013; Trompetter et al., 2014). One study did not find an effect on process (Ahtinen et al., 2103). The remaining studies did not report effect sizes on process measures.

Acceptability

Attrition

A 90% cut-off for completeness of follow-up was considered a low risk of attrition bias as used in a similar review (Free et al., 2013), and a conservative estimate of 50% was based on a meta-analysis of the mean psychotherapy drop-out rates being 46.86% (Wierzbicki, & Pekarik., 1993). The highest attrition rate was 98% with the lowest being 0%, and eight studies (50%) had an attrition rate of less than 10%. See table 4 for more details regarding the acceptability of interventions.

Table 4. Data regarding Attrition & Effectiveness

Reference	N Drop-out (%)	Reason for Drop Out	Missing Data	Effect Sizes	Achieved power
1.Ahtinen et al (2013) Finland	0	one participant excluded in the analysis due to unreliable timestamps in the log file	Not included in analysis.	**Within-group:** Pre- Post: primary outcome=stress *d*=1.55, p=0.003 process measure= psychological flexibility *d*=0.03, p=0.95;	1.00
2.Bricker et al 2013 USA	51 ACT: 52 control (total = 46.4%)	Disconnected phone (1 each condition), refused (1 each condition), No-response	Missing data was not input into analysis due to potential biases in effect size estimates being more liberal than non-inputted results.	**Between-group:** Post: primary outcome= quit rate intervention higher than control *d*=1.68, p=0.050; process= ACT to intervention reported greater acceptance of physical urges (p=0.001), cognitions (p=0.83), and emotions (p=0.22) effects sizes could not be calculated due to lack of data reported. Changes in total acceptance accounted for 80% of the effect on quit rate of intervention *d*=0.69, p<0.798.	1.00
Jones et al 2013 USA	27 ACT: 22 control (total = 52.1%)			**Between group:** Post: primary outcome= Quit rate = 20% ACT: 12% comparison; process= ACT was favourable to comparison and reported greater willingness to experience physical triggers *d*=0.70 *(*p=0.33) acceptance of cogitative triggers *d*=0.13 (p=0.67), and emotional triggers *d*=0.34 (p=0.13), and total acceptance *d*=0.54 (p=0.10).	
3.Bricker et al (2014) USA	18 ACT: 14 control (total = 16.3%)	18 ACT: 13 control. Reported as none-response.	Worst case scenario assumptions were not utilised	**Between group:** primary outcome= 30 day Quit rate higher in ACT to intervention: *d*=1.49, p=0.123. Among those scoring below median on acceptance of cravings at baseline quit rates were higher in ACT, *d*=1.6, p=0.211. Those that were heavy smokers at baseline quit rates were higher in ACT, *d*=0.99, p=0.692. Those that were not enrolled in another smoking cessation programme quit rates were higher in ACT, *d*=1.49, p=0.140.Higher acceptance of cravings was associated with quit rate *d*=0.34.	1.00

Reference	N Drop-out (%)	Reason for Drop Out	Missing Data	Effect Sizes	Achieved power
4.Buhrman et al (2013) Sweden	6 in each group (total = 16.4%)	9 ACT (3 declined, 6 'lost to follow up): 6 WL (6 'lost to follow-up').	Intention-to-treat	**Between group:** After for controlling for pre-test scores: primary outcome = CPAQ-Activity *d*=0.60, p=0.04, CPAQ-Pain willingness *d*=0.49, p=0.012, CPAQ-Total *d*=0.41, p=0.017; **Within group:** Control. Pre-post: primary outcome=CPAQ pain willingness *d*= 0.04, CPAQ total *d*=0.04. Treatment. Pre-post =CPAQ activity engagement *d*=-0.75, CPAQ pain willingness *d*=-0.70 , CPAQ total *d*=-0.80; Pre-FU, CPAQ activity engagement *d*=-0.60, CPAQ pain willingness *d*=-0.70, CPAQ total *d*=-0.87	0.11
5.Carlbring et al (2013) Sweden	5 (total = 6.25%)	3 ACT: 2 waitlist. lost to follow up (5)	Intention-to-treat	**Between group:** primary outcomes= BDI-II, *d*=0.98 (95%CI=0.51-1.44), MADRS-S *d*=0.64, p=0.002;	1.00
6.Chase et al (2013) USA	37 (total = 28%)		Intention-to-treat	**Between Group:** primary outcome =Grade point average: Pre: Post = Intervention group vs WL *d*=0.63, p=0.005(95%CI=-0.18,-0.04). Intervention vs control *d*=0.41, p=0.043(95%CI=0.002, 0.14). Control vs WL *d*=0.22, p=0.33(95%CI=-0.22, 0.04). Original intervention group deteriorated Intervention-control *d*=-0.04, p=0.20. **Within group:** primary outcome =Grade point average: Post: FU After WL given intervention *d*=0.51, p=0.012 (95%CI=0.02, 0.15). Control group *d*=0.46, p=0.083(95%CI=-0.01, 0.17). Original intervention group deteriorated *d*=-0.03, p=0.13.	1.00
7. Dahlin et al (2016) Sweden	(total = 17.5% post, 26% FU)	Post 10 ACT: 8 WL. FU 19 ACT 19 withdrew (6 ACT), 5 did not answer measures (4 ACT). FU 9 ACT didn't answer	Intention to treat	**Within group:** pre-post primary outcome= PSWQ treatment *d*=1.35 (95%CI=1.03,1.27), control *d*=0.49 (95%CI=0.21,0.77); GAD7 treatment *d*=1.89 (95%CI=1.4,2.34), control *d*=0.64 (95%CI=0.34,0.99); GAD-Q-IV treatment *d*=1.5 (95%CI=1.16,1.85), control *d*=0.85 (95%CI=0.59,1.13); FU treatment: primary outcomes=PSWQ *d*=1.71 (95%CI=1.2,2.25), GAD7 *d*=1.69 (95%CI=1.16,2.37), GAD-Q-IV *d*=3.91 (95%CI=2.95,4.78) **Between group:** Pre-post primary outcomes=PSWQ *d*=0.87 (95%CI=0.35,1.33), GAD7 *d*=0.98 (95%CI=0.52, 1.43), GAD-Q-IV *d*=0.70 (95%CI=0.2, 1.14)	1.00

Reference	N Drop-out (%)	Reason for Drop Out	Missing Data	Effect Sizes	Achieved power
8. Hesser et al (2012) Sweden **Hesser, Westin & Andersson (2014) Sweden**	6 (total =6.1%)	2 CBT, 4 ACT, 0 control None provided	Statistical assumptions of ignorable missing (missing at random) were utilised and the initial group sample size at baseline was analysed at follow-up.	**Between group:** Primary outcome= THI: CBT vs control *d*= 0.70, p=0.006 (95%CI=-17.03,-2.94); ACT vs control *d*=0.68, p=0.008(95%CI=-16.29,-2.53) favouring treatments; Main fixed linear effect of time *d*=1.34, p<0.001 (95%CI=-44.65,-20.45). CBT-ACT average rates of change not sig *d*=0.16, p=0.51(95%CI=-14.87, 11.21). Process measures: ACT and control pre-to post-treatment on TAQ *d*=0.59, p= 0.21, (95%CI=0.77, 9.09) and CBT vs control *d*=0.45, p=0.075, (95%CI=-0.40, 8.12). Active treatment across all measurement points irrespective of condition Cohen's *d* = 0.96, p<0.001, (95%CI=6.59, 20.68). This highlights increase in acceptance. **Within group:** THI across active treatment phase (pre-, mid-, post) *d*= 1.27, p<0.001, (95%CI=-23.6, -17.1)	1.00
9.Lappalainen et al (2014) Finland	3 (total= 7.9%)	0 ACT: 3 cnotrol (1 'lost to follow-up, 2 did not complete questionnaires)	Hierarchical linear modelling was utilised and missing at random assumptions was used.	**Between group**: Post Primary outcome= BDI-II g=0.15 (95%CI=-0.49, 0.80); 6 month: BDI-II g=-0.76 (95%CI=-1.44, -0.09); 18 month: BDI-II g=-0.51 (95%CI=-1.18, 0.17). Process measures: 6 month: AAQ-II g=0.34 (95%CI=-0.032, 1.00), KIMS g=0.35 (95%CI=-0.31, 1.00), ATQ-F g=-0.47 (95%CI=-1.13, 0.20), ATQ-B g=-0.23 (95%CI=-0.89, 0.42), WBSI g=-0.45 (95%CI=-1.11, 0.22). 18 month AAQ-II g=0.35 (95%CI=-0.32, 1.02), KIMS g=-0.02 (95%CI=-0.68, 0.65), ATQ-F g=-0.64, (95%CI=-1.32, 0.04), ATQ-B g=-0.17, (95%CI=-0.84, 0.50), ATQ-B g=-0.17 (95%CI=-0.84, 0.50), WBSI g=-0.27 (95%CI=-0.93, 0.40).	0.56
10.Levin, (2013) USA	45 ACT: 35 control (34.2%)	Not included in analysis due to participation in previous study (2 ACT). Randomly responded on 1 or more assessment points (2 ACT: 2 control). Others did not complete assessment	6 excluded from all analyses (4 ACT: 2 control) Intention to treat analysis.	**Between group:** Primary outcomes: Pre-3-month: DASS-anx *d*=0.34, p=0.009, DASS-stress *d*=0.46, p<0.001, lower stress in control to ACT at post *d*=0.34, p= 0.043. Process: pre-post ACT knowledge *d*=1.23, p<0.001, none-reactivity *d*=0.52, p=0.002, education values *d*=0.34, p=0.039. Pre-3 month psychological inflexibility *d*=0.67, p<0.001, none-reactivity *d*=0.43, p=0.001, relationship values *d*=0.26, p=0.086, education values *d*=0.29, p=0.039.	0.95

Reference	N Drop-out (%)	Reason for Drop Out	Missing Data	Effect Sizes	Achieved power
10. Cont. Levin, (2013) USA				**Within group:** Primary outcomes: Pre-3 month: control DASS-anx *d*=0.31, p=0.005, DASS-dep *d*=-0.05, p >0.10, DASS-stress *d*=0.35, p=0.001-0.11; ACT DASS-anx *d*=0.06, p >0.10, DASS-dep *d*=-8.14, p>0.10, DASS-stress *d*=-0.36, p=0.008. Process: pre-post control none-reactivity *d*=0.20, p=0.058. ACT none-reactivity *d*=0.37, p=0.006. Pre-1 month: control psychological inflexibility *d*=0.21, p=0.038, none-reactivity *d*=0.20, p=0.068, relationship values (worsening) *d*=-0.25, p=0.025. ACT none-reactivity *d*=0.46, p=0.001, education values (worsening) *d*=-0.29, p=0.036. Pre-3 month: control psychological inflexibility *d*=0.58, p<0.001, none-reactivity *d*=0.20, p=0.066. ACT psychological inflexibility *d*=0.55, p<0.001, none-reactivity *d*=0.37, p=0.008. **Between Group:** primary outcomes**:** post = DASS-d *d*=0.14, DASS-a *d*=0.01, DASS-s *d*=0.20; 1month DASS-d *d*=0.03, DASS-a *d*=0.15, DASS-s *d*=0.10; 3months DASS-d *d*=0.20, DASS-a *d*=0.08, DASS-s *d*=0.10. Process measures: pre-post ACT knowledge *d*=1.10, p<0.001. Pre-3 month Education value success *d*=0.23, p=0.088. **Within Group:** Treatment: primary outcomes pre-post= DASS-d *d*=-0.05, DASS-a *d*=0.03, DASS-s *d*=0.02; pre-1month= DASS-d *d*=-0.13, DASS-a *d*=-0.07, DASS-s *d*=0.05; pre-3month= DASS-d *d*=0.10, DASS-a *d*=0.30, DASS-s *d*=0.40.	0.95
10. Levin et al (2016) USA	41 ACT: 33 control (31.6%)		Intention to treat analysis		
Levin et al (2014) USA	3 ACT: 1 control 8%	Too busy (1), too busy with school (1 from each condition), unrelated life event (death of a close family member (1)	Hierarchical linear modelling provided a powerful method of the conducting analyses with full intention-to-treat sample as a use all available data and can model change even with missing data.	**Between group:** primary outcome: DASS-d *d*=0.40, p=0.095. Subgroup analysis with distressed students on primary outcome (DASS cut-off depression >=10, anxiety >=8, or stress >=15) DASS-a *d*=0.81, p=0.033, DASS-d *d*=0.91, p=0.018. Process: ACT knowledge *d*=1.47, p<0.001, education values success *d*=0.54, p=0.024, positive motivation *d*=0.51, p=0.035 all favouring treatment group. **Within group:** Primary outcomes: pre-FU in treatment group DASS-d *d*=0.97, p=0.001, DASS-a *d*=0.95, p=0.003, DASS-s *d*=0.81, p=0.001. Process: Experiential avoidance *d*=0.52, p=0.073, education positive motivation *d*=0.50, p=0.085, Education success *d*=0.92, p=0.033, relationships-positive motivation *d*=0.74, p=0.054, relationship success *d*=0.78, p=0.043. Pre-post in WL ACT knowledge *d*=1.12, p<0.001.	

Reference	N Drop-out (%)	Reason for Drop Out	Missing Data	Effect Sizes	Achieved power
11.Ljotsson et al (2013) Sweden	4 (9.8%)	lost to post treatment (1) did not complete the follow-up (3)	Missing data at post and follow-up were imputed using multiple imputation procedure in SPSS.	**Within group:** Pre-post: primary outcome= FIQ *d*=0.71, (95%CI=0.46, 0.97), FIQpain *d*=0.62, (95%CI=0.29, 0.95); Pre-FU, FIQ *d*=0.96 (95%CI=0.66-1.27), FIQpain *d*=1.22 (95%CI=0.81, 1.63); Post-FU, FIQ *d*=0.06 (95%CI=-0.19, 0.31), FIQpain *d*=0.36 (95%CI=0.06, 0.65); Process: Pre-post: PIPS *d*=1.56 (95%CI=1.11, 2.01). Pre-FU PIPS *d*=1.63 (95%CI=1.20, 2.07. Post-FU PIPS *d*=0.02 (95%CI=-0.25, 0.28).	0.10
12.Ly et al (2012) Sweden	0	Not stated	Not stated	**Within group:** BEVS *d* = -0.77, p<0.05, AAQ-II *d* = -0.50, p<0.05, SWLS *d*= -0.11, p>0.05, DASS-d *d*=0.38, P>0.05, DASS-a *d*=0.27, p>0.05, DASS-stress *d*=0.27, P>0.05 (primary not stated)	0.10
13.Ly et al (2014) Sweden	3 ACT: 2 WL (total = 6.8%)	3 ACT: 2 waitlist. Reasons not provided.	Intention-to-treat	**Between group:** Primary outcome=GHQ-12 *d*=0.41, (95%CI=-0.78, 1.52 **Within group:** Treatment group**:** primary outcome**=** GHQ-12 *d*=0.37 (95%CI=-0.78, 1.52); Control group: GHQ *d*=-0.18 (95%CI=-1.30, 0.95)	1.0
14. Murray et al (2015) Australia	10 (38.5%)			**Within group:** completers. Primary outcome= QoL *d*=0.72, p=0.011 (95%CI=89, 5.98); Primary outcome= QoL *d*=0.52, p=0.014 (95%CI=47, 3.76)	0.82
15.Nes et al (2012) Norway	4 (36.4%)	intervention being too time consuming (2), did not provide a reason (2)	Not accounted for	**Within group:** HbA1c *d* = -0.19. Standard deviations for other measures were not reported therefore effect sizes could not be calculated.	0.15
16.Newton (2013) USA	294 (98%)	Hard to come back (3), introspection=too much thought (1), no time (4), exploring values too difficult (1), content too long/verbose (1), tasks too difficult (1). Others did not respond.	Not accounted for	**Within group:** Pre – post primary outcomes= self-orientated perfection *d*=1.70, P<0.01 other-orientated perfection *d*=1.28, p<0.05, socially prescribed perfection *d*=0.69, p<0.05; process measure= AAQ-II *d*=-0.56, P<0.05.	0.43

Reference	N Drop-out (%)	Reason for Drop Out	Missing Data	Effect Sizes	Achieved power
17. Pots et al (2015) Netherlands	11 ACT: 20 EW: 8 WL (total = 16.5%)	2 didn't start intervention (1 ACT, 1 EW) reasons unknown, 29 completed <6 session (12 ACT, 17 EW) main reasons personal problems and that the intervention too time-consuming	Intention to treat analysis	**Between group:** post. Primary outcome= ACT-WL CES-D *d*=0.56; = CES-D *d*=0.36, clinical change post CES-D *d*=1.4 (95%CI=1.29,4.98) in favour of ACT, clinical change FU CES-D *d*=1.1 (95%CI=1.02,3.83) in favour of ACT; CES-D *d*=0.32;CES-D *d*=0.18 **Between group:** FU2: Process post: ECT-WL AAQ-II *d*=0.50, FFMQ-SF *d*=0.50; ACT-EW AAQ-II *d*=0.43, FFMQ-SF *d*=0.38; EW-WL AAQ-II *d*=0.13, FFMQ-SF *d*=0.19. FU ACT-WL AAQ-II *d*=0.41, FFMQ-SF *d*=0.43; ACT-EW AAQ-II *d*=0.28, FFMQ-SF *d*=0.29; EW-WL AAQ-II *d*=0.17, FFMQ-SF *d*=0.20.	0.79
18.Trompetter et al (2014) Netherlands	29 ACT: 19 EW: 15 WL (total= 30.7%)	Didn't fit pain complaints (ACT 2: EW 4), technical issues/inability to use intervention (ACT 3) no interest (EW 2), hospitalisation (ACT 1: EW2), able to cope (ACT 1: EW 1), time-consuming (ACT 2: EW 3), personal environment (ACT 2: EW 3) pain/illness (ACT 5: EW 1), started treatment (EW2) no reason (ACT 7: EW 11:WL15)	Intention to treat analysis	Between group: ACT to EW at 3 months: primary outcome= MPI d=0.33, p=0.008; Process: PIPS *d*=0.40, p=0.011. 6 months: Primary outcome= MPI *d*=0.47, p<0.001; Process PIPS *d*=0.47, p=0.002, PCS *d*=0.30, p=0.008. ACT to WL at 3 months. Process PIPS *d*=0.60, p<0.001, PCS *d*=0.39, p=0.13. 6 months: Process: PIPS *d*=0.54, p<0.001, FFMQ *d*=0.36, p=0.30, PCS *d*=0.38, p=0.19. Non-significant effects could not be calculated.	1.0

Note: ACT, acceptance and commitment therapy; CBT, cognitive behavioural therapy; WL, waitlist; FU, follow-up; *d*, Cohens d; p, significance level; CI, confidence interval; AAQ-II, acceptance and action questionnaire; DASS, depression, anxiety and stress scale; QoL, quality of life; GHQ, general health questionnaire; SWLS, satisfaction with life scale; BDI-II, beck's depression inventory; KIMS, Kentucky inventory of mindfulness skills; ATQ, automatic thoughts questionnaire (frequency or believability subscales); WBSI, white bear suppression inventory; THI, tinnitus handicap inventory; TAQ, tinnitus acceptance questionnaire; MADRS-S, montgomery–asberg depression rating scale**;** HADS, hospital anxiety and depression scale (anxiety, depression and stress subscales); CPAQ, chronic pain acceptance questionnaire; MPI, multidimensional pain inventory; FFMQ-SF, five-facet mindfulness questionnaire-short form; CES-D, centre for epidemiologic studies-depression scale; MHC-SF, mental health continuum-short form; When two articles present data on the same study they are shaded together.

Adherence to Intervention

10 studies reported how participants adhered to the intervention in terms of reporting on whether participants completed all modules, logged in as expected, and spent the expected amount of time using the intervention, or returned required reports such as diary entries. Adherence ranged from 27.5 % to 92%. With the exception of Newton (2014) where only 6 out of 300 completed all sessions.

Technology Usage

Again, many studies did not report on technology usage of participants within interventions. Of those that did, four (25%), reported on duration of usage. Overall duration of usage on average ranged from 12.3 minutes (SD=5.2, range= 4.4-24) to 270 minutes. Bricker et al. (2013) reported a significant difference between average usage of the ACT group compared to the control group (14 minutes: 9.29 minutes), and Levin et al. (2016) found that significantly more participants in the ACT group signed onto both lessons compared with the control group. Levin (2013) reported no significant difference on usage between groups. Four studies reported on the number of logins, and two found that there were significant differences between groups favouring the ACT groups. Levin (2013) reported on the percentage of participants that logged in to different sessions (see table 5), and Ly et al. (2012) reported "the majority of participants logged in a couple of times per week". Three other studies reported on whether diary reports were returned.

Satisfaction with Intervention

Nine studies (50%) reported on participant satisfaction with the intervention. Trompetter et al. (2014) reported a significant difference between satisfaction with the intervention between ACT and expressive writing (EW), favouring ACT. Other studies reported overall satisfaction to be higher in the intervention group rather than control group, but did not state whether this was a significant difference. The final three reported participants were satisfied with the interventions. Four studies reported on whether participants would recommend the intervention to others and two reported that those in the intervention group were more likely to recommend it to others. Whilst Murray et al. (2015) found 66.7% of participants would recommend the intervention to other people. Levin (2013) reported that the mean usability rating in both groups was 84.55 (SD=10.91), where the total score range was 20-100. A score of 80.3 or more represents the top 10% of program scores and those programs that people are likely to recommend to friends. See table five for more details regarding acceptability of interventions.

Table 5. Acceptability

Reference	Applicability of Intervention	Adherence to Intervention	Technology Usage	Satisfaction
1.Ahtinen et al (2013) Finland	47% said exercises concretely demonstrated how to use mindfulness in everyday life, that exercises regarded as interesting, concrete, down to earth, memorable, stories and metaphors helped to understand topics and the app included versatile topics and exercises in structured form. Changes to thoughts and attitudes (27%), gained ability to let go of thoughts and feelings and change perspective to them (27%).13% discussed values with spouse.		Average duration from first to last login event =34 days (SD5.3, range 26-46). The site was used on average 11.5 days (SD=5.8, range 4-20). There were on average 16.8 usage sessions (SD=9.0, range 5-36). Average duration of usage was 12.3 minutes (SD=5.2, range 4.4-24). Average total usage time per participant = minutes (SD=99, range 56-339). 60% made entries to diary which they reported that it enabled follow-up of thought when same exercises was repeated. 2 used paper as wanted to write and draw freely. 3 wanted more structure and pre-defined questions as found it difficult to know what to write.	Generally regarded as good platform for stress management. Main benefit was being able to take break amidst daily hassles.
2.Bricker et al 2013 USA **Jones et al 2013 USA**	60% ACT: 38% comparison said assigned programme was a good fit for them		Length of login was significantly different between groups (14 minutes ACT: 9.24 minutes comparison). Number of times logged in was not significantly different between groups (p=0.072; *M*=9.02, SD=13.53 ACT: *M*=5.46, SD=5.94). ACT group remained on the site for significantly longer than comparison (M=21.7 vs *M*=9.4; p=0.001) minutes.	74% overall satisfaction in ACT, 42% comparison, recommend to a friend = 69% ACT, 54% comparison.
3.Bricker et al (2014) USA	53% reported it was useful for quitting vs 38% comparator (p=10)		ACT group opened their app 2.5 times more often than comparison group (p=0.0001).	85% reported well organised vs 67% comparator (p=0.006), and 59% were satisfied overall vs 45% comparator (p=0.14).

Reference	Applicability of Intervention	Adherence to Intervention	Technology Usage	Satisfaction
4.Buhrman et al (2013) Sweden		Mean number of completed treatment sessions in treatment group was 4.2(SD =2.7). Adherence 39.5% (n=18) completed all 7 sections.		
5.Carlbring et al (2013) Sweden		Mean number of modules finished within 8 weeks of treatment was 5.1 (SD=1.7, MD = 5), out of the 7. 27.5% completed all 7 modules	Log in time ranged from 21-1449 min with a mean of 270 min and median 211.5min	
6.Chase et al (2013) USA				
7. Dahlin et al (2016) Sweden		76% completed all 7 modules		92.5% 'quite satisfied or better with the treatment and no participant reported being dissatisfied with the treatment'
8.Hesser et al (2012) Sweden Hesser Westin, & Andersson (2014) Sweden		69% completed more than half the treatment modules. No significant difference in condition between how many modules were completed.		

Reference	Applicability of Intervention	Adherence to Intervention	Technology Usage	Satisfaction
9.Lappalainen et al (2014) Finland				iACT *M* =8.42 (SD = 1.35): ACT *M*=8.83 (SD=0.86) on a scale of 1-10. Recommend to others (scale 1-10) iACT *M*=8.16 (SD=2.19): ACT *M*=9.06 (SD=1.26). At 18 month recommend to others iACT 94.7%: ACT 92.9%.
10.Levin, (2013) USA	"What was the most important thing you learnt?" 54% content from the values lesson, 46% from the acceptance	85% competed both modules within designated 3 weeks	Adequate amount of time spent on the programme (M=81.98 minutes, SD=22.68, *Mdn=77.57).* The majority logged on twice (58.1%), 3 times (21.6%), or 4/5 times (16.3%). No significant differences on program usage between ACT and WL (p >0.10). 85.3% reported reading the emails and 69% of those who read them reported engaging in the suggested exercises. Participants took 3.89 days on average to complete each lesson (*SD* = 2.57). More time spent on ACT website than MHE for both sessions: Session 1, d=2.77, p< .001; session 2 d=3.06, p< .001. Many completed the MHE sessions but perhaps with minimal actual program engagement (< 5 minutes). Usability ratings were equivalent t (173)=0.28, p=0.78. Usability rating (acceptability and usability) in both groups M=84.55 (SD=10.91), representing top 10% of programme scores and those programmes people are likely to recommend to friends.	
10. Cont. Levin et al (2016) USA		Significantly lower program completion rates for ACT than comparison for session 1 (ACT= 85%,comparison= 100%, $\chi2$ = 18.46, p<.001, *OR*=41.38) and session 2 (ACT= 55%, comparison = 86%, $\chi2$ = 25.14, p<.001, *OR*=4.77).		
Levin et al (2014) USA		92% completed both lessons.		

Reference	Applicability of Intervention	Adherence to Intervention	Technology Usage	Satisfaction
11.Ljotsson et al (2013) Sweden	Positive relationship between number of exercise reports and post treatment FIQ, controlling for pre-treatment FIQ *b*=-1.75, *t*(37)=2.19, and *p*=0.35. Implying for every exposure report participant returned, post-treatment FIQ would decrease by 1.75 points.	30 participants (73%) completed all 4 intro steps of treatment and commenced work with exposure exercises.	Mean number of exposure exercise reports retuned = 3.83 (SD = 3.02).	
12.Ly et al (2012) Sweden	Participant's reported the intervention made them think about their values and behaviours more		The majority of participants used the application a couple of times per week	
13.Ly et al (2014) Sweden		Adherence defined as min 2 registered activities in the app each week: 44% succeeded to adhere to all 6 weeks.		
14. Murray et al (2015) Australia	"I have noticed that when 'present' I have been able begin applying my values to my decision making", " I was able to stop 'defuse' and handle myself better when I felt overwhelmed", "More focused, more present, living in the now, recalled many of the symbols and find them quite useful (e.g. the pendulum)"			Participants were generally positive about the programmes content, structure, relevance and effectiveness. "I found guided meditations quite helpful", "As I am often online anyway, the venue was both convenient and relevant"

Reference	Applicability of Intervention	Adherence to Intervention	Technology Usage	Satisfaction
15.Nes et al (2012) Norway	Filling in the diaries had given participants better insight into their diabetes, increased their coping and self-management strategies. Feedback helped patients define their own goals based on health values, identify barriers related to goals achievement and develop strategies to overcome barriers. They became committed to their values and goals and most were willing to change their lifestyle to achieve a good health status. Those who did not work with their goals for achieving better diabetes management reported a sense of guilt		Diary response rate ranged from 21%-97%, with an average of 68%	Participants satisfied with participation and 'most' saw it as supportive, meaningful and motivating as gathered by diary entries, 'most' found diaries to be positive experience. Satisfaction with feedback rated 'high'.
16.Newton (2013) USA	"What were the most helpful aspects of this site?" (n=8) the following themes were created: (a) The program led to introspection or improved self-understanding.	only 6 completed all steps in program out of 300 who progressed past initial screens		
17. Pots et al (2015) Netherlands		73% ACT and 63% EW completed all 9 modules, p>0.05		
18.Trompetter et al (2014) Netherlands	After 6 months 77% of ACT p's reported to have incorporated mindfulness exercises into daily life- most often performed for 3 days per week (21%) for 15-20 minutes (36%).	92% finished all modules in both interventions		CSQ-8 - ACT (n=59) *M*=24.69 (SD=4.01), EW (n=51) *M*=21.39 (SD=4.79), p<0.001. Participant's graded intervention program from 1-10: ACT M=7.4 (SD=1.17, EW *M*= 6.5 (SD= 1.41), p=0.001.

Note: *M*, mean; *Mdn*, median; SD, standard deviation; n, sample size; ACT, acceptance and commitment therapy; EW, expressive writing; iACT, internet delivered acceptance and commitment therapy; CSQ, client satisfaction questionnaire; When two articles present data on the same study they are shaded together.

User Experience

Although reporting of user experience does not adequately address satisfaction according to the criteria of this review, it was deemed helpful to include it so participant's views about these types of interventions can inform future developers. Participants reported wanting programs which are easy to use and simple, that mobile phone programs are easier to transport than computer programs, apps should be easy to open, suitable for short easy exercises, to include reminders and immediate feedback, to be able to use the intervention on their personal device rather than a borrowed device, to have a variation in questions, have an overview of feedback, more information on specific things which would help their health condition e.g. diet, exercise. Things which were not found to be helpful were when it required a lot of commitment, content was too long or verbose, and there was scepticism to gamification aspects highlighted (Ahtinen et al., 2013; Nes et al., 2012; Newton, 2014).

Quality of Studies

The scores for quality could range from 0-41. The highest score was 33 (Levin, 2013; Levin et al., 2014; Levin et al., 2016), with the lowest being 17 (Murray et al., 2016; Newton., 2013). Six studies had 'not applicable' as a response to the fidelity of therapist criteria. This was because they did not use additional therapeutic contact, so the designs were stronger according to the criteria assessed in this review. Therefore a percentage score for all studies were also calculated with not applicable being deducted from the calculations. The highest percentage was 83% (Bricker at al., 2013; Jones et al., 2015), and the lowest was 44% (Murray et al., 2016; Newton., 2013). The overall quality of these studies, indicate that research carried out in this area appears to vary in the quality of studies according to the criteria of this review. Generally there appear to be consistent methodological weaknesses in allocation concealment and greater likelihood of detection bias across studies. There are inconsistencies in the type of study design used and whether the intervention was 'pure self-help' or 'guided self-help'. Generally studies have good effects and low attrition. Many studies did not report on technology usage, satisfaction, and applicability of treatment aspects. Data regarding quality criteria can be found in table 6.

Table 6. Data Regarding Quality Criteria

Reference	Type of study	Time point data collected	Therapist contact	Therapist fidelity	Sample Size	Power	Detection Bias	Allocation Concealment
1. Ahtinen et al (2013) Finland	Poor	Adequate	Adequate	Well	Poor	Well	Poor	Poor
2.Bricker et al (2013) USA Jones et al (2015) USA	Adequate	Adequate	Well	N/A	Well	Well	Well	Well
3.Bricker et al (2014) USA	Adequate	Adequate	Well	N/A	Adequate	Well	Well	Well
4.Buhrman et al (2013) Sweden	Adequate	Well	Poor	Adequate	Adequate	Poor	Poor	Poor
5.Carlbring et al (2013) Sweden	Adequate	Well	Poor	Adequate	Poor	Well	Poor	Poor
6.Chase et al (2013) USA	Well	Well	Well	N/A	Poor	Well	Well	Well
7. Dahlin et al (2016) Sweden	Well	Well	Poor	Well	Poor	Well	Poor	Poor
8. Hesser et al (2012) Sweden Hesser et al (2014) Sweden	Adequate	Well	Poor	Well	Poor	Well	Poor	Poor
9. Lappalainen et al (2014, a) Finland	Adequate	Well	Poor	Well	Poor	Poor	Poor	Poor
10. Levin (2013) USA Levin et al (2016) USA Levin et al (2014) USA	Well	Well	Poor	Well	Adequate	Adequate	Poor	Poor

Reference	Type of study	Time point data collected	Therapist contact	Therapist fidelity	Sample Size	Power	Detection Bias	Allocation Concealment
11. Ljotsson et al (2013) Sweden	Poor	Well	Poor	Well	Well	Poor	Poor	Poor
12. Ly et al (2012) Sweden	Poor	Adequate	Well	N/A	Poor	Poor	Poor	Poor
13. Ly et al (2014) Sweden	Adequate	Adequate	Poor	Well	Well	Well	Poor	Poor
14. Murray et al (2015) Canada	Poor	Adequate	Well	N/A	Poor	Adequate	Poor	Poor
15. Nes et al (2012) Norway	Poor	Adequate	Poor	Adequate	Poor	Poor	Poor	Poor
16. Newton (2013) USA	Poor	Adequate	Well	N/A	Poor	Poor	Poor	Poor
17. Pots et al (2016) Netherlands	Well	Well	Poor	Well	Well	Adequate	Poor	Well
18. Trompetter et al (2014) Netherlands	Well	Well	Poor	Well	Well	Well	Poor	Poor

Note: N/A, not applicable; when two articles present data on the same study they are shaded together.

Reference year	Effectiveness of intervention	Attrition	Adherence to intervention	Technology Usage	Applicability intervention aspects	Satisfaction	Total (%)
1. Ahtinen et al (2013) Finland	Well	Well	N.S	Well	Adequate	N.S	25 (61)
2.Bricker et al (2013) USA Jones et al (2015) USA	Well	Adequate	N.S	Well	Adequate	Well	32 (83)
3.Bricker et al (2014) USA	Well	Adequate	N.S	Well	Adequate	Adequate	30 (77)
4.Buhrman et al (2013) Sweden	Adequate	Adequate	Poor	N.S	Adequate	N.S	20 (49)
5.Carlbring et al (2013) Sweden	Well	Well	Poor	Poor	N.S	N.S	22 (49)
6.Chase et al (2013) USA	Adequate	Adequate	N.S	N.S	N.S	N.S	23 (59)
7. Dahlin et al (2016) Sweden	Well	Adequate	Adequate	N.S	N.S	N.S	23 (55)
8. Hesser et al (2012) Sweden Hesser et al (2014) Sweden	Well	Well	Adequate	N.S	Adequate	N.S	25 (61)
9. Lappalainen et al (2014, a) Finland	Adequate	Well	N.S	N.S	Adequate	Well	23 (56)
10. Levin, (2013) USA Levin et al (2016) Levin et al (2014) USA	Well	Well	Well	Adequate	Well	Well	33 (80)

Reference year	Effectiveness of intervention	Attrition	Adherence to intervention	Technology Usage	Applicability intervention aspects	Satisfaction	Total (%)
11. Ljotsson et al (2013) Sweden	Well	Well	Adequate	Adequate	Well	N.S	27 (66)
12. Ly et al (2012) Sweden	Poor	Well	N.S	Poor	Well	N.S	18 (46)
13. Ly et al (2014) Sweden	Poor	Well	Poor	N.S	N.S	N.S	21 (51)
14. Murray et al (2015) Canada	Adequate	Adequate	N.S	N.S	Adequate	N.S	17 (44)
15. Nes et al (2012) Norway	Poor	Adequate	N.S	Adequate	Adequate	Well	20 (49)
16. Newton (2013) USA	Well	Poor	Poor	N.S	Adequate	N.S	17 (44)
17. Pots et al (2015) Netherlands	Well	Adequate	Adequate	N.S	Adequate	N.S	28 (67)
18. Trompetter et al (2014) Netherlands	Poor	Adequate	Well	N.S	Adequate	Well	29 (70)

Note: N.S, not stated; N/A, not applicable; when two articles present data on the same study they are shaded together.

Discussion

Summary

The majority of studies used an internet intervention. The majority were randomised control trials using another form of treatment, an active control or waitlist. Generally the focus of the interventions were mental health and physical health. The study duration ranged from 3 weeks to 12 weeks, with the longest follow-up being 18 months. Only five studies had no additional therapeutic contact. Of those that included additional contact, information regarding the therapist and fidelity to treatment was scarce. However, personal communication from the authors revealed that the majority of studies that included additional contact did so under the supervision of or included training (or both) by experienced ACT therapists.

Overall it appears that the use of technology has been deemed acceptable and effective in delivering ACT. From those which met power the effectiveness on the primary outcome measure ranged from small to large. The studies which were found more effective varied in the methodological strength according to this review. This might indicate that we cannot be totally confident in our findings in relation to the effectiveness of these studies. More robust studies are required to enhance the validity of the findings. Only one study included a cost analysis which indicated that the intervention significantly reduced both direct and indirect health care costs. These types of interventions are similar to traditional psychotherapy in their acceptability, according to attrition rates. There were inconsistent findings in the overall acceptability of these types of interventions. For example not all studies reported on all aspects of acceptability the review considered. These included adherence to the intervention, technology usage, applicability of the intervention and satisfaction. There seemed to be a pattern that those interventions with fewer sessions retained a greater completion rate, potentially indicating that shorter interventions are deemed to be more acceptable to participants. This might also improve the effectiveness of such interventions, because if people are engaging with the ACT content more the intervention could be more likely to be effective. Only a few studies reported technology usage, and the findings indicated that overall participants interacted with the interventions as anticipated by the researchers. This highlights that participants used the interventions as directed and that these forms of interventions seem acceptable to participants. Those that were rated poorer in this category, tended to be poorer quality studies overall according to this review. Only half of the studies reported on patient satisfaction. Of the control designs that considered this, satisfaction with ACT treatment delivered via technology was higher than control. Of those that did not have control groups,

patients rated that they were satisfied with this form of treatment. Also, four studies reported on whether participants would recommend this form of treatment to a friend, and found that participants in the intervention groups were more likely to recommend the programme to others. Those without control groups found that more than half the participants would recommend the intervention to others. This further highlights that ACT delivered through smartphones or the internet is seen as acceptable to participants. Fourteen studies reported that participants were able to apply ACT skills into daily living, the other four studies did not report on this. Only half of the studies were sufficiently powered, so the reliability of these effects may be questioned (Button et al., 2013).

Limitations

Due to this being a relatively new topic of interest, studies included in this review used an array of study design, so comparisons were difficult to determine. Moreover, due to the nature of the interventions reviewed, it proved difficult to assess the treatment aspects of the interventions and make comparisons across studies. This review conceptualised therapist asynchronous contact as poorer quality than studies using no additional contact as it undermines the pure technology aspect and brings in a human angle. The researcher is aware that this type of contact could be more individually tailored to participants' needs, more responsive and flexible, so it may actually enhance the effectiveness of the intervention. Indeed research has indicated that guided interventions are significantly superior to non-guided interventions (Baumeister, Reichler, Munzinger, & Lin, 2014). One of the aims of Baumeister and colleagues review was to compare 'pure self-help' to 'guided self-help' and found that effect sizes did not appear to differ. There were limitations to these comparisons as it did not specify the type of psychological model the interventions were based on. This indicates that this feature needs more investigation on the impact of the effectiveness between 'pure' and 'guided' self-help with more comparable studies. The researcher is aware that protocols describing interventions that would have been likely to have been suitable for this review are being published regularly. This is clearly a rapidly growing area of research, but these published protocols were not included in this review as there was currently no outcome data to assess.

Implications in Terms of Design Features

This is seen to be an acceptable mode of delivery for ACT amongst varying health conditions and mental health difficulties. Participants appear to be satisfied with this form of delivery, and have highlighted important aspects which were more helpful. For example participants appear to favour apps which are mobile phone based, easy to use, interactive, and provide a

summary of feedback. It seems that mobile app delivery could be an important platform to encourage delivery of treatment and would fit society download trends (Statista, 2015). The majority of development thus far seem to have been web-based. An implication of this is that developers need to work with software developers and designers to make such apps which are user friendly and interactive. Difficulties arise in how to calculate costs of such developments in grant applications, how much user testing should be involved and at what stages, what ethical procedures are required for involving participant's in the development of apps given they might be being asked to try out untested technologies.

As mentioned earlier there were consistent methodological weaknesses in allocation concealment, a greater likelihood of detection bias across studies, and inconsistencies in study design. These methodological limitations mean that there cannot be total confidence in the findings and scientific rigour of the methodology in these types of studies. This highlights that future research should consider RCT's where participants and researchers are blinded to group allocation. Also, as many studies did not report on technology usage, satisfaction, and applicability of treatment aspects, these aspects should be focused on to make firmer conclusions in these areas. It would also be interesting to determine whether technology usage impacted on effect sizes in future research, (i.e. in a dose/response relationship).

Future Evaluation of Apps

With the growing number of recently published protocols in this area of research, it is hoped that these studies will again be used in a similar review. This is to not only determine the robustness of these types of studies in this field, but also to determine the effectiveness of these interventions as hopefully a larger number of studies utilising similar methodologies can be compared and firmer conclusions could be drawn. This is so clinicians can be confident if they suggest using such an intervention to patients, that they are a scientifically evidence based form of treatment.

As previously mentioned the influence of additional asynchronous therapist contact may enhance the overall effectiveness of the intervention. Indeed there is research to indicate that guided internet interventions generate superior results to unguided approaches, albeit a small effect (Baumeister et al., 2014). Their study also aimed to assess the effectiveness of asynchronous compared to synchronous therapeutic contact, however their search only generated one study incorporating both forms of contact so comparisons between asynchronous and synchronous contact could not be determined. The researcher is aware of

preliminary data regarding the efficacy and cost-effectiveness of participants receiving an online ACT intervention for chronic pain with guidance versus the same intervention with no guidance (Lin & Lüking, unpublished). This review found that when studies were grouped together dependant on whether asynchronous contact was used or not, it appeared that additional contact did not improve the effectiveness of the intervention. This would pose the question whether additional resources are needed into these interventions, or whether therapist's time could be spent elsewhere. More research is needed with similar methodologies that are rigorous to make firmer conclusions. It would be useful to conduct more randomised control trials to compare the same interventions with no contact and asynchronous contact, or for individual studies to conduct cost-analyses considering this aspect of treatment, or a meta-analysis to compare interventions using additional contact to those that do not.

Future app development is ideally placed to not only evaluate the effectiveness of the overall intervention, but to simultaneously conduct research on process. There has been a growing interest in module based research and it has found to outperform usual care and manualised treatment (Chorpita et al., 2013). There has also been research into separating out different components from the psychological flexibility model to create a module based approach. This indicated the ACT model lends itself to this type of treatment approach (Villatte et al., 2016). This was conducted on adults and the authors highlight the importance of repeating the research in different settings. Having a module approach is responsive to individual's needs and it personalises treatment more than the usual manualised approach. The main difficulty in assessing which elements of treatment are effective is that component analyses are required to determine how they impact on process and outcome. To make this type of approach effective, algorithms are relied on to determine which components to implement in given situations (Villatte et al., 2016). Apps provide an easy way to produce these algorithms and to implement experienced sampling methodology where data can be assessed after each component. They can track certain content a person engages with, track choices, determine fidelity and people's engagement. If apps are designed in a module way, they could provide an accessible platform to complete treatment component dismantling studies.

Incorporating Apps to Support Direct Care

There are broadly two types of use for these apps. Firstly, to enhance access of treatment to populations which do not normally access health care. The development of such interventions could improve access to populations that are in geographically remote areas, and those who do not normally seek access to services. This is an ongoing pressure felt internationally by

healthcare systems (Australian Government, 2010; Donaghy, 2012; Richards & Bower, 2011; Vine, 2011). This means wider populations would have greater opportunity to receive treatment. This is in-line with addressing issues highlighted in documents and policies worldwide (Peachey, Hicks and Adams, 2013; Preventive Services Task Force, 2012; Australian Government Department of Health, 2010; Scottish Government, 2005).

Secondly, these apps could be used as a support to people in direct treatment as part of an ongoing treatment plan. The apps could be a form of interactive self-help and so would more likely target those individual's with mild to moderate difficulties according to UK recommendations (NHS Education for Scotland, 2011; NICE 2009), and would be seen as low intensity intervention according to the stepped care model (Scottish Government, 2015). This could potentially have implications for people needing to access one-to-one support, as it could be used as a more preventative measure in addressing mild to moderate difficulties. If problems were treated earlier on, then the propensity for untreated difficulties to deteriorate would lessen. This has further implications in terms of impacting on waiting times. There are UK targets to meet 18 week referral to treatment, with the current lack of resources this target is not being met by many health boards across the UK. If people could access tailored self-help which is responsive to data imputed, then many people could access the treatment needed and would not need to be seen by a healthcare team for treatment. This would not only have implications in terms of societal well-being, but also could reduce the waiting lists, so those that are in need of more in-depth support would be able to get quicker access to support. This would mean that there would potentially be a reduction in people presenting in crisis making for a better quality of life, as people would feel more confident they could access support in a timely manner when it was needed. In more complex presentations, technology could enhance the face-to-face therapy and support the work by generalising it outside of the therapy session. This has implications for therapists in delivering existing face-to-face treatment. If the use of technology becomes more a feature of the therapeutic context or indeed standard practice, it could potentially affect the training of therapists. It raises the question whether training courses need to include education on how to set-up and programme such devices to deliver work between sessions, and how to use such technology to support therapeutic sessions.

Conclusion

In conclusion this review found that generally that ACT delivered through technology was found to be both effective and acceptable to participants. The majority of studies to date evaluate web-based interventions, yet feedback from participants highlights preference to more portable interventions. It would be useful to develop more smartphone based interventions to determine whether this improves technology usage, acceptability or the effectiveness of this form of treatment. As mentioned, consistent methodological weaknesses reduce confidence in the findings, and should be addressed in future research. It would also be useful to determine the cost-effectiveness of such interventions, including whether having additional therapeutic support changes the cost-effectiveness. Overall, the findings are promising and this review hopefully highlights where future app development is required.

Conflict of Interest

None.

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References

Ahtinen, A., Mattila, E., Välkkynen, P., Kaipainen, K., Vanhala, T., Ermes, M., … Lappalainen, R. (2013). Mobile mental wellness training for stress management: Feasibility and design implications based on a one-month field study. *Journal of Medical Internet Research*, *15*(7). Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84883413359&partnerID=40&md5=4189982e7d26eff698b823dfa349fd0c

Australian Government (2010). The Department of Health: The Better Access Initiative. Assed on 19.1.15 from http://www.health.gov.au/internet/publications/publishing.nsf/Content/mental-ba-eval-dexec-toc~mental-ba-eval-dexec-bet

Barker & Gillanders (2015). Efficacy, feasibility and utility of using technology to deliver acceptance and commitment therapy: a systematic review. PROSPERO 2015:CRD42015020419 Available fromhttp://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42015020419

Baumeister, H., Reichler, L., Munzinger, M., & Lin, J. (2014). The impact of guidance on Internet-based mental health interventions — A systematic review. *Internet Interventions*, *1*(4), 205–215. http://doi.org/10.1016/j.invent.2014.08.003

Block-Lerner, J., Wulfert, E., & Moses, E. (2009). ACT in Context: An Exploration of Experiential Acceptance. *Cognitive and Behavioral Practice*, *16*(4), 443–456. http://doi.org/10.1016/j.cbpra.2009.04.005

Borenstein, M. (Ed.). (2009). *Introduction to meta-analysis*. Chichester, U.K: John Wiley & Sons.

Bricker, J. B., Mull, K. E., Kientz, J. A., Vilardaga, R., Mercer, L. D., Akioka, K. J., & Heffner, J. L. (2014). Randomized, controlled pilot trial of a smartphone app for smoking cessation using acceptance and commitment therapy. *Drug and Alcohol Dependence*, *143*, 87–94. http://doi.org/10.1016/j.drugalcdep.2014.07.006

Bricker, J., Wyszynski, C., Comstock, B., & Heffner, J. L. (2013). Pilot Randomized Controlled Trial of Web-Based Acceptance and Commitment Therapy for Smoking Cessation. *Nicotine & Tobacco Research*, *15*(10), 1756–1764. http://doi.org/10.1093/ntr/ntt056

Buhrman, M., Skoglund, A., Husell, J., Bergström, K., Gordh, T., Hursti, T., … Andersson, G. (2013). Guided internet-delivered acceptance and commitment therapy for chronic

pain patients: A randomized controlled trial. *Behaviour Research and Therapy*, *51*(6), 307–315. http://doi.org/10.1016/j.brat.2013.02.010

Button, K. S., Ioannidis, J. P. A., Mokrysz, C., Nosek, B. A., Flint, J., Robinson, E. S. J., & Munafò, M. R. (2013). Power failure: why small sample size undermines the reliability of neuroscience. *Nature Reviews Neuroscience*, *14*(5), 365–376. http://doi.org/10.1038/nrn3475

Carlbring, P., Hägglund, M., Luthström, A., Dahlin, M., Kadowaki, Å., Vernmark, K., & Andersson, G. (2013). Internet-based behavioral activation and acceptance-based treatment for depression: A randomized controlled trial. *Journal of Affective Disorders*, *148*(2-3), 331–337. http://doi.org/10.1016/j.jad.2012.12.020

Chase, J. A., Houmanfar, R., Hayes, S. C., Ward, T. A., Vilardaga, J. P., & Follette, V. (2013). Values are not just goals: Online ACT-based values training adds to goal setting in improving undergraduate college student performance. *Journal of Contextual Behavioral Science*, *2*(3-4), 79–84.

Chorpita, B. F., Weisz, J. R., Daleiden, E. L., Schoenwald, S. K., Palinkas, L. A., Miranda, J., … Research Network on Youth Mental Health. (2013). Long-term outcomes for the Child STEPs randomized effectiveness trial: A comparison of modular and standard treatment designs with usual care. *Journal of Consulting and Clinical Psychology*, *81*(6), 999–1009. http://doi.org/10.1037/a0034200

Cuijpers, P., van Straten, A., & Andersson, G. (2008). Internet-administered cognitive behavior therapy for health problems: a systematic review. Journal of behavioral medicine, 31(2), 169-177.

Dahlin, M., Andersson, G., Magnusson, K., Johansson, T., Sjögren, J., Håkansson, A., … Carlbring, P. (2016). Internet-delivered acceptance-based behaviour therapy for generalized anxiety disorder: A randomized controlled trial. *Behaviour Research and Therapy*, *77*, 86–95. http://doi.org/10.1016/j.brat.2015.12.007

Donagh. J., (2012). Breaking the Silence in Rural Areas: Rural Mental Health, Stigma, Services and Supports within the SWARD Region. Accessed on 10.12.15 from: http://www.niamhlouisefoundation.com/wp-content/uploads/2010/12/the_niamh_louise_foundation_breaking_the_silence_in_rural_areas_research_2012__sward___1_.pdf

Donker, T., Petrie, K., Proudfoot, J., Clarke, J., Birch, M.-R., & Christensen, H. (2013). Smartphones for Smarter Delivery of Mental Health Programs: A Systematic Review. *Journal of Medical Internet Research*, *15*(11), e247. http://doi.org/10.2196/jmir.2791

Dunst, C. J., Hamby, D. W., & Trivette, C. M., (2004). Guidelines for Caluculating Effect Sizes for Practice-Based Research Synthesis. *Centerscope: Evidence-Based Approaches to Early Childhood Development*, 3(1), 1-9.Durlak, J. A. (2009). How to Select, Calculate, and Interpret Effect Sizes. *Journal of Pediatric Psychology*, *34*(9), 917–928. http://doi.org/10.1093/jpepsy/jsp004

Durlak, J. A. (2009). How to select, calculate, and interpret effect sizes.*Journal of pediatric psychology*, jsp004.

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*,*39*, 175-191.

Free, C., Phillips, G., Galli, L., Watson, L., Felix, L., Edwards, P., … Haines, A. (2013). The Effectiveness of Mobile-Health Technology-Based Health Behaviour Change or Disease Management Interventions for Health Care Consumers: A Systematic Review. *PLoS Medicine*, *10*(1), e1001362. http://doi.org/10.1371/journal.pmed.1001362

Hayes, S. C., Bissett, R., Korn, Z., Zettle, R. D., Rosenfarb, I., Cooper, L., & Grundt, A. (1999). The impact of acceptance versus control rationales on pain tolerance. *The Psychological Record*, *49*(1), 33-47.

Hayes, S. C., Luoma, J. B., Bond, F. W., Masuda, A., & Lillis, J. (2006). Acceptance and commitment therapy: model, processes and outcomes. *Behaviour Research and Therapy*, *44*(1), 1–25. http://doi.org/10.1016/j.brat.2005.06.006

Hayes, S.C, Strosahl, K.D., & Wilson, K.G. (2012). *Acceptance and commitment therapy: The process and practice of mindful change* (2nd edition). New York, NY: The Guilford Press.

Hayes, S. C., Villatte, M., Levin, M., & Hildebrandt, M. (2011). Open, Aware, and Active: Contextual Approaches as an Emerging Trend in the Behavioral and Cognitive Therapies. *Annual Review of Clinical Psychology*, *7*(1), 141–168. http://doi.org/10.1146/annurev-clinpsy-032210-104449

Hedman, E., Ljótsson, B., & Lindefors, N. (2012). Cognitive behavior therapy via the Internet: a systematic review of applications, clinical efficacy and cost–effectiveness. *Expert Review of Pharmacoeconomics & Outcomes Research*, *12*(6), 745–764. http://doi.org/10.1586/erp.12.67

Hesser, H., Gustafsson, T., Lundén, C., Henrikson, O., Fattahi, K., Johnsson, E., … Andersson, G. (2012). A randomized controlled trial of internet-delivered cognitive behavior therapy and acceptance and commitment therapy in the treatment of tinnitus. *Journal*

of Consulting and Clinical Psychology, *80*(4), 649–661. http://doi.org/10.1037/a0027021

Hesser, H., Westin, V. Z., & Andersson, G. (2014). Acceptance as a mediator in internet-delivered acceptance and commitment therapy and cognitive behavior therapy for tinnitus. [Cognitive Therapy [3311]].

Higgins, J. P. T., Green, S., & Cochrane Collaboration (Eds.). (2008). *Cochrane handbook for systematic reviews of interventions*. Chichester, England ; Hoboken, NJ: Wiley-Blackwell.

Hofmann, S., Sawyer, A., Witt, A., & Oh, D. (2010). The Effect of Mindfulness-Based Therapy on Anxiety and Depression: A Meta-Analytic Review.

Jones, H. A., Heffner, J. L., Mercer, L., Wyszynski, C. M., Vilardaga, R., & Bricker, J. B. (2015). Web-based acceptance and commitment therapy smoking cessation treatment for smokers with depressive symptoms. [Psychotherapy & Psychotherapeutic Counseling [3310]]. Retrieved 4 January 2002, from

Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: a practical primer for t-tests and ANOVAs. *Frontiers in Psychology*, *4*. http://doi.org/10.3389/fpsyg.2013.00863

Lappalainen, P., Granlund, A., Siltanen, S., Ahonen, S., Vitikainen, M., Tolvanen, A., & Lappalainen, R. (2014). ACT Internet-based vs face-to-face? A randomized controlled trial of two ways to deliver Acceptance and Commitment Therapy for depressive symptoms: An 18-month follow-up. *Behaviour Research and Therapy*, *61*, 43–54. http://doi.org/10.1016/j.brat.2014.07.006

Levin, E. M., & Hayes, S. C., (2013). Evaluating a Prototype Acceptance and Commitment Training Web-Based Prevention Program for Depression and Anxiety in College Students (Unpublished Doctoral Dissertation). University of Nevada, Reno.

Levin, M. E., Hayes, S. C., Pistorello, J., & Seeley, J. R. (2016). Web-based self-help for preventing mental health problems in universities: Comparing acceptance and commitment training to mental health education. [Psychological & Physical Disorders [3200]].

Levin, M. E., Pistorello, J., Seeley, J. R., & Hayes, S. C. (2014). Feasibility of a Prototype Web-Based Acceptance and Commitment Therapy Prevention Program for College Students. *Journal of American College Health*, *62*(1), 20–30. http://doi.org/10.1080/07448481.2013.843533

Lin & Lüking, (unpublished). Efficacy and Cost-Effectiveness of a Guided and Unguided Online-Based Acceptance and Commitment Therapy for Chronic Pain: a Three-

Armed Randomized Controlled Trial. Accessed on 19.1.16 from https://contextualscience.org/wc13_symposia_detail

Ljotsson, B., Atterlof, E., Lagerlof, M., Andersson, E., Jernelov, S., Hedman, E., … Wicksell, R. K. (2014). Internet-delivered acceptance and values-based exposure treatment for fibromyalgia: A pilot study. *Behavioral & Psychological Treatment of Physical Illness*.

Luxton, D. D., McCann, R. A., Bush, N. E., Mishkind, M. C., & Reger, G. M. (2011). mHealth for mental health: Integrating smartphone technology in behavioral healthcare. *Professional Psychology: Research and Practice*, *42*(6), 505–512. http://doi.org/10.1037/a0024485

Ly K.H., Asplund K., & Andersson G. (2014). Stress management for middle managers via an acceptance and commitment-based smartphone application: A randomized controlled trial. Retrieved from http://www.journals.elsevier.com/internet-interventions/

Ly, K. H., Dahl, J. A., Carlbring, P., & Andersson, G. (2012). Development and initial evaluation of a smartphone application based on acceptance and commitment therapy. *SpringerPlus*, *1*(1), 1–11.

Murray, G., Leitan, N. D., Berk, M., Thomas, N., Michalak, E., Berk, L., … Kyrios, M. (2015). Online mindfulness-based intervention for late-stage bipolar disorder: pilot evidence for feasibility and effectiveness. *Journal of Affective Disorders*, *178*, 46–51. http://doi.org/10.1016/j.jad.2015.02.024

Nes, A. A. G., van Dulmen, S., Eide, E., Finset, A., Kristjánsdóttir, Ó. B., Steen, I. S., & Eide, H. (2012). The development and feasibility of a web-based intervention with diaries and situational feedback via smartphone to support self-management in patients with diabetes type 2. *Diabetes Research and Clinical Practice*, *97*(3), 385–393. http://doi.org/10.1016/j.diabres.2012.04.019

Newton, B. (2014). Development and evaluation of an online self-help program for perfectionism using cognitive therapy and acceptance concepts. [Health & Mental Health Treatment & Prevention [3300]]. Retrieved 1 January 1974, from http://gateway.proquest.com/openurl?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&res_dat=xri:pqm&rft_dat=xri:pqdiss:3562215

NICE (2006). Computerised Cognitive Behavioural Therapy for Depression and Anxiety: Nice Technology Appraisal Guidance. Accessed on 7.1.16 from https://www.nice.org.uk/guidance/ta97

NICE (2009). Depression in adults: The treatment and management of depression in adults Accessed on 10.12.15 from: http://www.nice.org.uk/guidance/cg90/chapter/1-recommendations

NHS Education for Scotland (2011). The Matrix: Mental Health in Scotland: A Guide to delivering evidence-based Psychological Therapies in Scotland. Retrieved on 17.1.15 from: http://www.nes.scot.nhs.uk/media/20137/Psychology%20Matrix%202013.pdf

Pal, K., Eastwood, S. V., Michie, S., Farmer, A. J., Barnard, M. L., Peacock, R., ... & Murray, E. (2013). Computer-based diabetes self-management interventions for adults with type 2 diabetes mellitus. Cochrane Database Syst Rev, 3.

Peachey, D. Hicks, V. and Adams, O., (2013). An Imperative for Change Access to Psychological Services for Canada. Accessed on 10.12.15 from http://www.cpa.ca/docs/File/Position/An_Imperative_for_Change.pdf

Pots, W., Fledderus, M., Meulenbeek, P., ten Klooster, P., Schreurs, K., & Bohlmeijer, E. (2016). Acceptance and commitment therapy as a web-based intervention for depressive symptoms: randomised controlled trial.

Recommendation from the Community Preventive Services Task Force for Use of Collaborative Care for the Management of Depressive Disorders. (2012). *American Journal of Preventive Medicine*, *42*(5), 521–524. http://doi.org/10.1016/j.amepre.2012.01.010

Richards, D. A., & Bower, P. (2011). Equity of access to psychological therapies. *The British Journal of Psychiatry*, *198*(2), 91–92. http://doi.org/10.1192/bjp.bp.110.083485

Scottish Government (2005). Delivering for Health. Retrieved on 19.1.15 from: http://www.scotland.gov.uk/Resource/Doc/76169/0018996.pdf

Scottish Government (2015) Stepped care model: Increasing the Availability of Evidence-Based Psychological Therapies in Scotland. Retrieved on 19.1.15 from *www.gov.scot/Resource/Doc/924/0051490.doc*

SIGN (2010). Scottish Intercollegiate Guidelines Network. Non-pharmaceutical management of depression in adults: A national clinical guideline. Retrieved on 17.1.15 from: http://www.sign.ac.uk/pdf/sign114.pdf

Statista (2015). Number of mobile app downloads2009-2017/Statistic. 19.1.15 Retrieved from: http://www.statista.com/statistics/266488/forecast-of-mobile-app-downloads/

Thorsell, J., Finnes, A., Dahl, J., Lundgren, T., Gybrant, M., Gordh, T., & Buhrman, M. (2011). A Comparative Study of 2 Manual-based Self-Help Interventions, Acceptance and Commitment Therapy and Applied Relaxation, for Persons With Chronic Pain:

The Clinical Journal of Pain, *27*(8), 716–723. http://doi.org/10.1097/AJP.0b013e318219a933

Trompetter, H. R., Bohlmeijer, E. T., Veehof, M. M., & Schreurs, K. M. G. (2014). Internet-based guided self-help intervention for chronic pain based on Acceptance and Commitment Therapy: A randomized controlled trial. *Journal of Behavioral Medicine*. http://doi.org/10.1007/s10865-014-9579-0

Twohig, M. P. (2012). Acceptance and Commitment Therapy. *Cognitive and Behavioral Practice*, *19*(4), 499–507. http://doi.org/10.1016/j.cbpra.2012.04.003

University of Alabama (2015). *School of Public Health:* Accessed on 26.06.15 from: http://www.soph.uab.edu/Statgenetics/People/MBeasley/Courses/EffectSizeConversion.pdf

Villatte, J. L., Vilardaga, R., Villatte, M., Plumb Vilardaga, J. C., Atkins, D. C., & Hayes, S. C. (2016). Acceptance and Commitment Therapy modules: Differential impact on treatment processes and outcomes. *Behaviour Research and Therapy*, *77*, 52–61. http://doi.org/10.1016/j.brat.2015.12.001

Vine. R., (2011). Equity in health and wellbeing: Why does regional, rural and remote Australia matter? *InPsych.* Accessed on 10.12.2015 from: https://www.psychology.org.au/Content.aspx?ID=3960

Wierzbicki, M., & Pekarik, G. (1993). A meta-analysis of psychotherapy dropout. *Professional Psychology: Research and Practice*, *24*(2), 190.

Yuen, E. K., Herbert, J. D., Forman, E. M., Goetter, E. M., Comer, R., & Bradley, J.-C. (2013). Treatment of Social Anxiety Disorder Using Online Virtual Environments in Second Life. *Behavior Therapy*, *44*(1), 51–61. http://doi.org/10.1016/j.beth.2012.06.001

Supplementary Online Material

Appendix 1. Inclusion and Exclusion Criteria

	Inclusion	Exclusion
Population	Male or female. Human. Any age.	
Intervention	Interventions based on Acceptance and Commitment Therapy. Delivered through technology which includes smartphones and internet. The intervention has to have an interactive element. Contact with therapist if only used for initial interviews, for a session at the end to debrief or plan for the future once participants have stopped using the intervention, or data collection. Asynchronous contact via technology e.g. email, smart-phone. Technological support.	The use of technology to enhance self-help workbooks or face-to-face therapy. No real-time therapist contact to deliver ACT based interventions either face-to-face, by phone, email or virtual portals. No face-to-face therapy to be running concurrently with the study. Mindfulness-based therapy. No real-time therapeutic support delivered either face-to-face or through uses of different technology such as telephone, or skype, or interactive messaging service.
Comparator	All studies with or without a comparator group will be included	
Outcomes	Physical or emotional health outcomes, participant feedback, psychological flexibility, behaviour change	
Study Design	RCTs, control trials, pilot studies, comparison studies, longitudinal studies, none control studies	Cross sectional studies, protocols, qualitative, reviews , commentaries, poster conferences, editorials

Note: RCT, randomised control trial; ACT, acceptance and commitment therapy

Appendix 2.Quality Criteria

	Type of study	Time point data collected	Therapist contact	Therapist fidelity	Applicability intervention aspects	Detection Bias	Allocation Concealment
Well covered	RCT (can include W/L as control)	Pre, post and follow-up.	No clinical contact or inbuilt automatic responses from the intervention itself.	Therapist / app developers receives supervision from an experienced ACT practitioner & training provided to therapist.	*d*=>0.80 on process measure at any time point	Coders and researchers analysing findings blinded to group allocation	Participants unaware of what group they are allocated to
Adequately covered	A none randomised control trial	Pre & post	Contact to describe the study and/or end contact to collect data and deliver feedback/plan for the future once the participant has stopped using the intervention.	Therapist/app developers receives supervision &/or training provided to therapist	*d*=0.50<.80 at any time point, or qualitative data on participant's experiences of the intervention made them more aware of valued action and barriers which get in the way of living a value consistent life, or participants are able to apply ACT techniques to their daily lives and report it has improved quality of life.	Not applicable – this risk of bias was seen to be either high (poorly covered) or low (well covered)	Participants aware of different groups in the study, so could make assumptions about their group.

	Type of study	Time point data collected	Therapist contact	Therapist fidelity	Applicability intervention aspects	Detection Bias	Allocation Concealment
Poorly addressed	Feasibility or pilot studies	Only baseline measurements	Asynchronous contact with therapist.	No training provided to therapist/ app developer and/or no supervision	*d*<0.50 on process measure at any time point, or qualitative data on participant's experiences of the intervention did not make them more aware of valued action and barriers which get in the way of living a value consistent life	Coders & researchers analysing findings aware of group allocation. Where there was only one group (no comparator)	Participants told which group they are in. Where there was only one group (no comparator). Where waitlist only control = assumed participants knew
Not Applicable	Qualitative aspects of user experience	Where studies have only looked at user experience	Where focus groups or interviews are held to gather feedback on user experience after participants used the intervention. Technological support	Where there was no additional therapeutic input	Where the study did not collect data on process	Where researchers are expected to generate feedback from participants about the intervention usability	

	Sample Size	Power	Effectiveness of intervention	Reliability	Attrition Bias	Adherence to intervention	Technology Usage	Satisfaction
Well covered	A priori calculation conducted and assumed drop out accounted for in final sample	1.00, study met power	Large effect (d=>0.80) on primary outcome at any time point. If a cost analysis was conducted, or reductions in healthcare costs for individual and/or NHS or government	Post Hoc calculation and sample was within 10% of power (<90). This means 90% of the findings are likely to be correct	<90% attrition. Reason for drop out stated and not due to intervention. If outcome data are missing in both groups (where comparators used) and reasons for these are both reported and balanced across groups	=>90% of participants continue to log into the intervention throughout the duration of the study	There is a significant difference between the number of login's in the comparison group to the intervention group. Or the average login length is significantly different between the comparison group to the intervention group. Where no comparator was used the number of log-in events is in line with the number of sessions, or in line with the expectations of the researchers, or =>90% response rate to exercises (low risk of bias to adherence, Free et al., 2013)	Very satisfied with the intervention. Or there was a 2SD (%) difference between satisfaction with the intervention group to comparison group, favouring the intervention (where a comparator was used). Significant difference in satisfaction measures pre to post intervention.

	Sample Size	Power	Effectiveness of intervention	Reliability	Attrition	Adherence to intervention	Technology Usage	Satisfaction
Adequately covered	A priori calculation conducted but drop out not stated whether accounted for	0.80-.099. 0.80 = conventionally accepted (NICE., 2012)	Medium effect (*d*=>0.50, <0.80) on primary outcome at any time point. If a Cost analysis was conducted, no change in healthcare costs for individual and/or NHS or government.	Post Hoc calculation and power was =<0.50-90. This means that 50%-90% of the findings are likely to be correct	None-significant difference of drop out across groups. Reasons for drop out not stated, or drop out of intervention group is 50%-90% (a conservative estimate of adherence based on Wierzbicki, & Pekarik., 1993)	50%-90% (A conservative estimate of adherence based on Wierzbicki, & Pekarik., (1993) of participants continue to log into the intervention throughout the duration of the study	There is a none-significant difference between the number of login's, or average login between the comparison group to the intervention group. Where no comparator was used the number of log-in events is 50%-90% with the number of sessions, duration of each session is 50%-90% the time the researchers expected, or 50%-90% response rate to exercises based on conservative estimate of adherence based on Wierzbicki, & Pekarik., (1993)	Fairly satisfied. Or there was <2SD (%) difference between satisfaction with the intervention group to comparison group, favouring the intervention (where a comparator was used). None significant difference in satisfaction measures pre to post intervention.

	Sample Size	Power	Effectiveness of intervention	Reliability	Attrition	Adherence to intervention	Technology Usage	Satisfaction
Poorly addressed	No a priori calculation conducted	<0.80	Small or no effect (*d*<0.50) on primary outcome at any time point. If a cost analysis conducted, increases in healthcare costs for individual and/or NHS or government. Or no calculations conducted	Post Hoc calculation and end power was <50%. This means less than 50% of the findings are likely to be correct	Significant difference across groups. Intervention attrition is >50%. Based on a conservative estimate was based on Wierzbicki, & Pekarik., (1993) then less than 50% adherence is seen to be poor methodologically.	<50% of participants continue to log into the intervention throughout the duration of the study. Based on a conservative estimate was based on Wierzbicki, & Pekarik., (1993) then less than 50% adherence is seen to be poor methodologically.	No difference between number of login's in comparison group to intervention group (where comparator used), or there is no difference in average login length between comparison group to intervention group (where comparator used). Where no comparator was used, number of log-in events is <50% with the number of sessions, or the duration of each session is less <50% time researchers expected, or <50% response rate to exercises	Not satisfied. Or there was no difference between satisfactions with the intervention group to comparison group, favouring the intervention (where a comparator was used). No difference in satisfaction measures pre to post intervention.

Note: RCT, randomised control trial; ACT, acceptance and commitment therapy; N/A, not applicable

Appendix 3. Reasons for Excluding Studies from the Review

Article	Reference, year & country	ACT based intervention used	Was the intervention delivered through internet, smartphone or portable devises?	Was real-time therapist contact used other than in an initial or final appointment or data collection?	Was the use of technology the main intervention?	Does the study report outcomes on effectiveness?	Is the study a RCT, control trial, pilot, comparison, longitudinal or none control study?	Decision	Other notes
1	Ahtinen et al 2013 Finland	Yes	Yes	No	Yes	Yes	Yes	Include	
2	Bricker et al 2013 USA	Yes	Yes	No	Yes	Yes	Yes	Include	
3	Bricker et al 2014a USA	Yes	Yes	No	Yes	Yes	Yes	Include	
4	Bricker et al 2014 USA	Yes	Yes	Yes	Yes	Yes	Yes	Exclude	telephone calls not smartphone
5	Buhrman et al 2013 Sweden	Yes	Yes	No	Yes	Yes	Yes	Include	
6	Carlbring et al 2013 Sweden	Yes	Yes	No	Yes	Yes	Yes	Include	
7	Chase et al 2013 USA	Yes	Yes	No	Yes	Yes	Yes	Include	
8	Cheng et al 2013 Japan	Yes	Yes	No	Yes	No	Yes	Exclude	Protocol

Article	Reference, year & country	ACT based intervention used	Was the intervention delivered through internet, smartphone or portable devises?	Was real-time therapist contact used other than in an initial or final appointment or data collection?	Was the use of technology the main intervention?	Does the study report outcomes on effectiveness?	Is the study a RCT, control trial, pilot, comparison, longitudinal or none control study?	Decision	Other notes
9	Dahlin et al 2016 Sweden	Yes	Yes	No	Yes	Yes	Yes	Include	
10	Dilorio et al 2011 USA	No	Yes	No	Yes	Yes	Yes	Exclude	It doesn't state what type of intervention is used, looking at the measures used there are none which look at aspects of psychological flexibility or ACT concepts. Therefore it is presumed that ACT is not used.

Article	Reference, year & country	ACT based intervention used	Was the intervention delivered through internet, smartphone or portable devises?	Was real-time therapist contact used other than in an initial or final appointment or data collection?	Was the use of technology the main intervention?	Does the study report outcomes on effectiveness?	Is the study a RCT, control trial, pilot, comparison, longitudinal or none control study?	Decision	Other notes
11	Fledderus et al 2015 Netherlands	Yes	Yes	Yes	No	No	Yes	Exclude	Patients to have completed a group programme
12	Hayes et al 2014 USA	Yes	Yes	No	Yes	No	Yes	Exclude	Protocol
13	Heffner et al 2015 USA	Yes	Yes	No	Yes	No	Yes	Exclude	
14	Heffner et al 2013 USA	Yes	Yes	No	Yes	No	Yes	Exclude	
15	Hesser et al 2012 Sweden	Yes	Yes	No	Yes	Yes	Yes	Include	
16	Hesser et al 2014 Sweden	Yes	Yes	No	Yes	Yes	Yes	Include	
17	Jones et al 2015 USA	Yes	Yes	No	Yes	Yes	Yes	Include	

Article	Reference, year & country	ACT based intervention used	Was the intervention delivered through internet, smartphone or portable devises?	Was real-time therapist contact used other than in an initial or final appointment or data collection?	Was the use of technology the main intervention?	Does the study report outcomes on effectiveness?	Is the study a RCT, control trial, pilot, comparison, longitudinal or none control study?	Decision	Other notes
19	Ishola and Chipps 2015. South Africa	Yes	Yes	No	Yes	No	Yes	Exclude	protocol
20	Kelders et al 2013 Netherlands	Yes	Yes	No	Yes	No	No	Exclude	Design/Development study
21	Kohle et al 2015 Netherlands	Yes	Yes	No	Yes	No	Yes	Exclude	protocol
22	Kristjansdottir et al 2011 Norway	Yes	Yes	Yes	No	Yes	Yes	Exclude	Received 4 week inpatient programme.
23	Kristjánsdóttir et al 2013 Norway	Yes	Yes	Yes	No	Yes	Yes	Exclude	Received 4 week inpatient programme.
24	Lappalainen et al 2014a Finland	Yes	Yes	No	Yes	Yes	Yes	Include	

Article	Reference, year & country	ACT based intervention used	Was the intervention delivered through internet, smartphone or portable devises?	Was real-time therapist contact used other than in an initial or final appointment or data collection?	Was the use of technology the main intervention?	Does the study report outcomes on effectiveness?	Is the study a RCT, control trial, pilot, comparison, longitudinal or none control study?	Decision	Other notes
25	Lappalainen et al 2013 Finland	Yes	Yes	Yes	No	Yes	Yes	Exclude	face to face meetings, one of which delivered psychological intervention
26	Lappalainen et al 2014b Finland	Yes	Yes	No	Yes	No	No	Exclude	protocol
27	Lappalainen et al 2015 Finland	Yes	Yes	Yes	Yes	Yes	Yes	Exclude	Initial meeting gathered data on patients individual problems which informed personalised feedback

Article	Reference, year & country	ACT based intervention used	Was the intervention delivered through internet, smartphone or portable devises?	Was real-time therapist contact used other than in an initial or final appointment or data collection?	Was the use of technology the main intervention?	Does the study report outcomes on effectiveness?	Is the study a RCT, control trial, pilot, comparison, longitudinal or none control study?	Decision	Other notes
28	Levin et al 2013 USA	Yes	Yes	No	Yes	Yes	Yes	Include	
29	Levin et al 2014 USA	Yes	Yes	No	Yes	Yes	Yes	Include	
30	Levin et al 2015 USA	Yes	Yes	No	No	Yes	Yes	Exclude	Emailed author who confirmed that the students were already receiving face-to-face therapy.
31	Levin et al 2016 USA	Yes	Yes	No	Yes	Yes	Yes	Include	
32	Lin et al 2015 Germany	Yes	Yes	No	Yes	Yes	No	Exclude	Protocol
33	Ljotsson et al 2014 Sweden	Yes	Yes	No	Yes	Yes	Yes	Include	contacted Dr Ljotsson who stated it was not real time

Article	Reference, year & country	ACT based intervention used	Was the intervention delivered through internet, smartphone or portable devises?	Was real-time therapist contact used other than in an initial or final appointment or data collection?	Was the use of technology the main intervention?	Does the study report outcomes on effectiveness?	Is the study a RCT, control trial, pilot, comparison, longitudinal or none control study?	Decision	Other notes
34	Ly et al (2012) Sweden	Yes	Yes	No	Yes	Yes	Yes	Include	Ly et al (2012) Sweden
35	Ly et al 2014 Sweden	Yes	Yes	No	Yes	Yes	Yes	Include	
36	Mak & Loke 2012 Hong Kong	Yes	No	Yes	Yes	No	Yes	Exclude	Protocol
37	Moffitt & Mohr 2015	Yes	No	No	No	Yes	Yes	Exclude	Received workbook detailing programme. Intervention delivered through information book and DVD
38	Morlander et al 2015 Sweden	Yes	Yes	No	Yes	No	Yes	Exclude	protocol
39	Murray et al 2015 Canada	Yes	Yes	No	Yes	Yes	Yes	Include	

Article	Reference, year & country	ACT based intervention used	Was the intervention delivered through internet, smartphone or portable devises?	Was real-time therapist contact used other than in an initial or final appointment or data collection?	Was the use of technology the main intervention?	Does the study report outcomes on effectiveness?	Is the study a RCT, control trial, pilot, comparison, longitudinal or none control study?	Decision	Other notes
40	Nes et al 2012 Norway	Yes	Yes	No	Yes	Yes	Yes	Include	
41	Newton (2013) USA	Yes	Yes	No	Yes	Yes	Yes	Include	
42	Pots et al 2015 Netherlands	Yes	Yes	No	Yes	Yes	Yes	Include	
43	Schimmel-Bristow wt al 2012 USA	Yes	Yes	No	Yes	No	No	Exclude	Looking at fidelity between face-to-face and internet delivered
44	Sveen et al 2015 Sweden	Yes	Yes	No	Yes	No	Yes	Exclude	Protocol
45	Trompetter et al 2014 USA	Yes	Yes	No	Yes	Yes	Yes	Include	

Empirical Paper

The utility of an ACT based app for young people with type 1 diabetes: An account of user's experiences

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(Word Count: 6237)

[2] Gillian Radford was my clinical supervisor for the first year and a half, Sarah Ross has been my clinical supervisor for the second year and a half, and David Gillanders was my academic supervisor.

Abstract

Background: Successful self-management of type 1 diabetes (TD1) poses significant psychological challenges during adolescence. Acceptance and Commitment Therapy (ACT) shows promise as a theoretically and practically relevant intervention. The problem faced in delivering such an intervention is one of volume. A potential solution is to design a theoretically driven mobile application. In the first instance, adolescents with TD1 should evaluate the application based on their experiences of using it.

Methods: A purpose built application (SweetSpot) was created, that combined diabetes self-monitoring, with strategies from ACT to reduce avoidance of diabetes and related cues and promote healthy engagement in life. Nine individuals used SweetSpot for four weeks and were interviewed about their experiences. Narrative accounts were transcribed and analysed using framework analysis.

Results: Two main themes were evident in the data: 'Desire for apps to represent my needs' and 'How diabetes impacts me and how this could potentially be addressed in an app'.

Discussion: Adolescents were positive about SweetSpot, yet there was a high risk of disengagement. This could be due to using avoidance as a coping strategy. The majority of adolescents reported that they did not struggle with their diabetes, yet went on to discuss psychological difficulties they experience living with diabetes. ACT seems an appropriate intervention to target these difficulties. Findings highlighted the need to target avoidance early on. SweetSpot showed promise in helping adolescents with TD1 become more independent in decision making around glucose management.

Key words: Acceptance and Commitment Therapy, Type 1 Diabetes, Adolescents, Android Application

Introduction

Type 1 diabetes (TD1) usually occurs in childhood (American Diabetes Association, 2009). Five-ten percent of patients are diagnosed with TD1 (Daneman, 2006). TD1 is increasing at a rate of 3.4% (Svensson et al., 2009), and 497,100 children are currently living with TD1, with 79,100 newly diagnosed annually (International Diabetes Federation, 2014). It is important for patients to control glucose levels (measured by HbA1c), to prevent health complications. Poor glycaemic control is a risk factor for heart failure (Iribarren et al., 2001), neuropathy (Adler et al., 1997) and renal failure (McCullough et al., 1997). Patients with better glycaemic control report better functioning and wellbeing (Renders et al., 2001).

During adolescence, physical, social and psychological factors can make coping with diabetes difficult (Channon, 2005). This could be due to pubertal endocrine changes influencing HbA1c (Hochhauser, 2008). It is also often a time where experimentation with drugs, alcohol, and sexual behaviours occur (Court, Cameron, Berg-Kelly, & Swift, 2009). Moreover, there tends to be increased autonomy in self-management and diet which has been associated with poorer self-care (Hamilton & Daneman, 2002).

Eighty-four percent of children with TD1 in England and Wales do not achieve recommended blood glucose targets (Diabetes UK, 2013). Adherence to medication and other treatments can decline in adolescents with chronic illnesses (Pai & Ostendorf, 2011). Transition from paediatric to adult services can lead to patients withdrawing from healthcare services (Singh, 2009). Other life changes, such as moving away from home may also contribute to difficulties with diabetes management (Helgeson et al., 2013). Adolescence is an important time for developing self-management interventions, and psychosocial interventions are superior to education alone during this transition, leading to better health outcomes, reduced emotional distress and better glycaemic control (Savage, Farrell, McManus, & Grey, 2010; Winkley, 2006).

When adolescents are becoming more autonomous with their diabetes care, they increase their responsibility to make regular blood checks, manage and monitor a healthy diet and engage in regular exercise. These self-management behaviours are associated with psychosocial barriers such as: family conflict around independence, worries around appropriate diet, emotional struggles to take charge of daily burden of self-management, fears of self-injecting, feelings of hopelessness about managing blood glucose levels, fitting diabetes into daily life, peer influences such as fear of friends having negative reactions to their diabetes, anxiety in social

situations, and concerns about fitting in (Borus & Laffel, 2010; Karlsson et al., 2008). Some of these barriers involve unpleasant thoughts and feelings. People typically respond to such 'private events' by attempting to control or avoid them and the situations that lead to them. Acceptance and Commitment Therapy (ACT) is an approach which promotes behaviour change despite these difficult experiences (Gregg, Almada, & Schmidt, 2011).

An ACT model conceptualises living with diabetes, distress, the need for self-management and the threat of long-term complications, as part of the disease trajectory to be observed and noticed whilst remaining focused on behaving in a healthy manner (Gregg, Almada, & Schmidt, 2011). The mechanism underlying this approach is psychological flexibility. This is to bring attention to current behaviour, such as bringing awareness to thoughts, and other difficult internal experiences, aiming to live a life the patient would value without attempts at controlling or avoiding distressing experiences. Therefore it seems plausible that ACT could aid behaviour change for adolescents with diabetes whilst recognising the challenges that individuals face.

Evidence for ACT in diabetes comes from cross-sectional (Ciarrochi, & Bilich, 2006) and intervention work (Gregg et al., 2007). Psychological flexibility has been negatively associated with diabetes related worry, and positively associated with adherence and quality of life in adolescents with TD1 (Ciarrochi, & Bilich, 2006). ACT is superior to education alone at three month follow-up for diabetes self-care and HbA1c levels in an adult population with type 2 diabetes (TD2). Acceptance and self-management behaviours mediated the impact of ACT group treatment on HbA1c (Gregg et al, 2007). These findings need to be replicated in adolescents with TD1. A significant challenge to using ACT to help adolescents live well with TD1, is the availability of trained ACT therapists and the relatively low efficiency of delivering psychological interventions on either a one–to-one or group basis. Improving access to psychological therapies is seen to be problematic across therapies and recognised as a worldwide issue (Richards & Bower, 2011). Given the scope of the problem, designing theoretically derived interventions that can be delivered in large volume, with relevant concern for safety, effectiveness and quality is a priority for health care organisations.

An innovative way that could help promote self-management is through the use of technology. Few apps provide a comprehensive method for diabetes management when based on monitoring to promote behaviour change (Demidowich, Lu, Tamler, & Bloomgarden, 2012). Adults with TD2 reported a web-based disease management programme provided a safe

environment where concerns about diabetes were valued (Ralston, Revere, Robins, & Goldberg, 2004). Healthcare delivered by mobile technology has been acceptable to adolescents with diabetes, but did not significantly improve quality of life, and few adolescents reported increases in blood glucose monitoring (Carroll, DiMeglio, Stein, & Marrero, 2011). This intervention used monitoring to promote behaviour change. Text-message support aiming to encourage adolescents with TD1 to self-monitor resulted in significant increases in self-management and adherence, but no significant improvements in glycaemic control (Franklin, & Green, 2007). Although technology is seen as acceptable by adolescents, purely promoting self-monitoring is not beneficial in increasing quality of life or HbA1c. It would be important for interventions to be shaped as much as possible according to the precise challenges faced by the individual. ACT delivered through technology shows promise (Barker, Randell, & Gillanders, submitted). Adults with TD2 reported an ACT smartphone app was acceptable, it improved quality of life and reduced diabetes related stress (Nes et al., 2012). This is yet to be replicated in adolescents with TD1. It is paramount that these types of interventions are seen as acceptable and accurately represent adolescents with TD1 experiences. It is important to investigate what features are more likely to be used and what adolescents would like from these apps. If this is not robustly addressed engagement may be compromised and the apps may be less effective.

To summarise; TD1 poses significant healthcare risks, though successful management of the condition can lead to normal functioning. There are significant psychological challenges to successful self-management. These can be readily understood from a contextual behavioural science perspective and ACT shows promise as a theoretically and practically relevant intervention. The problem faced in delivering such an intervention is one of volume. A potential solution to this is to design a theoretically driven mobile application that is interactive, individually shaped and combines self-management behaviours with mindfulness, acceptance and values interventions to address barriers to self-management. In the first instance such an application needs to be robustly evaluated, according to the experiences of adolescents with TD1 of using an ACT based app. The aim of this study was to establish whether young people with TD1 found an ACT based app acceptable and whether they can see future utility in such an app.

Methodology

This was a qualitative study using individual interviews. Adolescents with TD1 used the app for a minimum of four weeks. The interviews were carried out within NHS Lothian. Ethical approval was granted by NHS Lothian Research Ethics Committee (15/SS/0064).

App Development

An ACT based app called SweetSpot was developed by EB and DG. This was informed by clinicians in the field, "The Acceptance and Commitment Therapy for Diabetes Self-management Therapist Manual" (Gregg, Hayes, & Callaghan; http://www.sjsu.edu/people/jennifer.gregg/courses/c3/s1/ACT_ED_therapist_manual.pdf), and "The Paedatric Diabetes Handbook" (The paediatric handbook (http://www.nhslothian.scot.nhs.uk/Services/A-Z/DiabetesService/Pages/ChildrenAdolescents.aspx). The process included: advertising the project to potential programmers and supervisors from the informatics department, developing relationships with clinicians in the field to make sure all diabetes information was accurate, creating graphics for the app and ensuring the app responded to inputted data correctly. The app included 6 chapters with 2-6 sessions per chapter. Each chapter aimed to target the six different processes in ACT. These are: present moment awareness, committed action, self-as-context values, cognitive defusion, and acceptance/willingness. The app aimed to help participants recognise when their behaviours are moving them towards what is important, or whether they are getting in the way of living a value driven life, through tracking these behaviours. For example participants were asked whether they identify with any of the following: Don't want to have diabetes, Embarrassed about having diabetes, Don't want to be seen as different from your friends, Feeling that diabetes is getting in the way of sport you want to play, Being frightened of having a hypo, Feeling that diabetes getting in the way of socialising, I think that diabetes is causing arguments with my parents, Feeling fed up with having diabetes, Thinking I will be told off by health care professionals. The one's that participants selected were then input into 'The Matrix' tab. The Matrix is a tool devised by Professor Kevin Polk, aiming to help people track whether their behaviours move them away or towards what is important to them. These behaviours can be in the mind or through the 5 senses. In the example above, if a participant had selected "Feeling fed-up with having diabetes", this would have been placed in the mind, away quadrant. As this thought is moving the person away from living a value driven life. The app also aimed to identify when participants are using avoidance and control strategies and highlighted that trying something

new. For example: “So far your experiences have told you some of your current behaviours relating to your diabetes are not working. Although you don’t like having diabetes, unfortunately it is not going away. How about we try something new? How about we make room for those feelings that we don’t like having diabetes?” and a willingness Mp3 was accessible. The app included mp3s, video clips, animation, and text (see table 1).

Table 1. SweetSpot Content

Chapter (session number)	Content	Psychological Process Targeted
Introduction	Introduction to the app and the study, consent, and demographic details	
1: Identifying Problems (3)	Participant's select issues that they find difficult and how they usually respond to these difficulties. These patterns of behaviours participants monitor and track are placed in the matrix. . Passengers on the bus introduced using a you tube clip (https://www.youtube.com/watch?v=Z29ptSuoWRc). Participants begin creating familiar passengers and can add passengers to their bus at any time. Creative hopelessness exercises are introduced to deliver the notion that their current behaviours are not working and they now have a choice to try something new (broken computer metaphor is included here).	Creative Hopelessness Acceptance and willingness Defusion
2: A choice to be willing (2)	Introduction to willingness as an alternative to usual behaviours. 'Making room' metaphor included as MP3 for participants to listen to. Introduction to present moment awareness and description of the mind usually being on auto-pilot. Mindfulness MP3 included aiming to make the participant more present moment focused.	Willingness work continued Present moment awareness
3: What's important to us? (2)	Introduction to values through 'compass metaphor' MP3. Identifying personal values through 'what's your direction' MP3. Participants track this by using the 'Values Bullseye' process measure. The content is reflective of participant's responses.	Values

Chapter (session number)	Content	Psychological Process Targeted
4: How to move towards what we care about? (3)	Identifying potential barriers to living by values identifies in chapter 3 and tracking these barriers on the matrix or by adding passengers to the participant's bus. Willingness to take these passengers and committing to making a step towards them through using 'Jump metaphor' MP3. Defusion exercise 'I notice I'm having the thought that…' is used to try and make potential barriers have less power over participants.	Willingness/Acceptance Defusion Committed Action Values
5: How to work with obstacles?	Identifying barriers that got in the way of value-driven behaviours. Identifying potential areas of life that can be a struggle and the selection acts as an individual session. These are: School, University, Work, Socialising, Relationships, and Family. 'Ball and chain' and 'chessboard' metaphors used within the different areas. Practical solutions to overcome some barriers are also suggested. E.g. talking to a teacher about having a private room to test blood and inject insulin at school.	Willingness/Acceptance Defusion Values Committed Action
6: Keeping going (2)	Maintenance and re-commitment 'make a commitment, break a commitment' exercise introduced. Participant choose whether the matrix or passengers on the bus works better for them and there is a systematic phasing out of prompts which help participants to generalise flexible behaviour without so much support from the app.	Defusion Committed Action Values

Chapter (session number)	Content	Psychological Process Targeted
Daily Measures	Daily blood glucose readings, injecting behaviours and a self-rating of diet and exercise. Participants can set alarms for the timing of these. The participants are able to review their responses and different graphs show their progress. The participants have the choice to respond to these reminders by inputting their data, asking to be reminded later, or not inputting it at all. Subsequent content is tailored to the response provided by participants.	

Procedure

People aged 13-22 years with TD1 who had been diagnosed for six months or more were recruited during their routine diabetes clinics. Participants had to speak and understand written English. Purposive sampling was used to generate a gender balance, and to gather mixed experiences of diabetes management. For example the psychologist or diabetes nurse specialist identified patients who either have poor glucose control or experience psychological difficulties in relation to their diabetes, or those who appear to be managing well. Participants who volunteered to take part were given an android tablet to use SweetSpot for one month and asked to take part in an interview. One participant chose to download SweetSpot onto their phone. Written consent was obtained within SweetSpot. Verbal consent for interviews was reiterated prior to the interview. Recruitment was from December 2015-Febuary 2016. Semi-structured interviews were conducted on NHS Lothian sites from January 2016-April 2016. The interview schedule can be seen in supplementary online material (appendix 1). One participant became upset during their interview and said that they appreciated talking about this during their interview and they found the app helpful. Once they completed their interview, further support was offered which they declined. EB conducted the interviews.

Analysis[3]

Transparency in data collection and analysis, reflexivity of potential biases, sensitivities to differing viewpoints, and testing the validity of responses were adopted throughout (Hannes, Lockwood, & Pearson, 2010; Long, Godfrey, Randall, Brettle, & Grant, 2002; Yardley, 2000). Audio recordings were transcribed by EB; familiarisation with the data co-occurred. The transcribed audio recordings were re-read and initial codes were noted with memos. Tabulation was used throughout. This produced a concise way to group codes together to create sub-themes. Triangulation was used as DG read a random sample of the transcripts and identified themes using the same method. EB and DG discussed their interpretations to derive a consensus. This clarified the themes and reduced the likelihood of individual biases. The data were scrutinised for disconfirming evidence to reduce potential confirmation bias. Themes were entered into a matrix as a systematic way to compare findings. It clarified the frequency of themes appearing across the whole data set and within cases to determine patterns. Member checking was conducted to determine whether themes were a valid representation of participant's viewpoints.

[3] For the purpose of the journal article the analysis section is brief. The expanded methodology is in the supplementary online materials. Appendix 2.

In qualitative research, assumptions must be made transparent. EB adopted a position described as 'empathic neutrality'. This perspective assumes research cannot be value free. It was important therefore to continually reflect on this to reduce the likelihood of bias. The choice of analytic method is also important in this regard. Framework analysis was used as it shows transparency in interpretations of what the participant is saying (Lacey, & Luff, 2007; Onwuegbuzie, Dickinson, Leech, & Zoran, 2009; Ritchie, Spencer, Bryman, Burgess, 1994), and aims to provide recommendations by gathering specific information (Gale, Heath, Cameron, Rashid, & Redwood, 2013).

Participants

Twenty seven people met inclusion criteria. Seventeen volunteered to take part in the study. Reasons for not wanting to participate were not having enough time because of exams, or reasons were not provided. Eight participants who initially agreed subsequently withdrew, with reasons being: not having enough time because of exams (n=4), not attending their interviews (n=3), and problems with the device (n=1). Seventy-five percent were female aged between 15-17years, length of diagnosis *Mdn*=90months (*range*=11months-138months). There were no significant differences between those that participated and those that dropped-out. The nine participants were aged between 15-16years, length of diagnosis *Mdn*=57months (*range*=24 months-184months), and 44.4% were female (see table 2).

Table 2. Participant Characteristics

Participant Pseudonym	**Gender**	**Age (Years)**	**Duration of Diabetes (Months)**
Alison	F	16	102
Helen	F	16	36
Hamish	M	16	57
Freya	F	15	40
Finley	M	16	184
Lilly	F	16	68
Rory	M	16	24
Albie	M	15	29
Joe	M	15	153

Results

Two themes were created and outlined in table 3.

Table 3. Summary of Themes and Sub-Themes

Themes	Sub-themes	Description
1. Desire for apps to represent my needs	1.1 The app is useful if you have specific goals or general difficulties.	1.1 Participants said they found SweetSpot helpful when they had specific goals. It encouraged participants to independently focus on their diabetes management which is something they strive for.
	1.2 It's helpful, I liked it.	1.2 Participants generally found SweetSpot helpful.
	1.3 Struggling verses not struggling	1.3 It seems that some participants cope well with having diabetes. Others identified difficulties, and some found it hard to communicate their struggles.
	1.4 Disengagement.	1.4 Some participants stopped using SweetSpot due to: dissatisfaction with the responsiveness, repetitiveness, and responses not accurately reflecting participant's experiences as they do not feel they struggle with their diabetes, exam stress, and work commitments.

Themes	Sub-themes	Description
2. How diabetes impacts me and how this could potentially be addressed in an app	2.1 Always on your mind.	2.1 Most participants felt that diabetes was always at the back of their minds. One participant spoke about battling with avoidance and acceptance.
	2.2 Controls life.	2.2 Many participants felt diabetes controls activities they can take part in, acts as a barrier for career aspirations, and gets in the way at school. One participant described feeling trapped between trying to control their diabetes without feeling controlled by it.
	2.3 Seeing yourself as different can create stigma or embarrassment.	2.3 Many participants said they felt different to their friends. Some were accepting of this. Others tried to pretend they were 'normal'. Others thought people might try and hide having diabetes through fear of being judged. Some said people made negative judgements about their diet which did not reflect their lifestyle.
	2.4 Having Support	2.4 Many participants highlighted that support from others was fundamental in helping them adapt to their diagnosis. They highlighted that people should seek support if they are struggling. There were suggestions of incorporating into SweetSpot giving advice, frequently asked questions (FAQ's), and networking with experts in the field; whether that be medics or through other people with diabetes.

Desire for apps to represent my needs

Participants found SweetSpot helpful if they had specific goals. They wanted apps to be responsive to their experiences of living with diabetes. Some participants felt SweetSpot did not represent their needs or did not understand some of SweetSpot's content, creating disengagement.

The app is useful if you have specific goals or general difficulties

Adolescents with TD1 seemed to suggest they were made to feel like they need to be the perfect patient and that unrealistic expectations might be placed on them, creating discordance.

> It's [SweetSpot] made me kinda want to make my blood sugars better. And sometimes it's quite hard to like be bothered about that. Being told that like, aye, blood sugars been high [at clinic]…you're like not as bothered when you're, you see it and you're like oh. It's kinda annoying coz you're like, you've failed at diabetes. It's kinda like, oh sorry…I mean you could even have like a feature that you might like set a goal for yourself and then build up to it…But if you get told on the app that would be better yeah. (Albie)

> And it was fine putting it in and stuff, but looking back, it like, you realise how hectic some of my readings are and stuff, which helped me think what to change. (Finley)

This indicates how self-reflection is an important but potentially neglected aspect of care.

It's helpful, I liked it

Some participants highlighted that SweetSpot raised questions they had not previously thought about, which they found beneficial.

> I realised it [SweetSpot] was bringing up things that I didn't know. And I thought well, that's quite interesting, and I didn't know all these things were related to my diabetes…Erm, well I think it did help, because obviously it made me realise. Like the whole thing made me sort of realise this is important. (Lilly)

This highlights how the process of self-management requires adolescents to acquire accurate and clear knowledge of their condition, its impacts, fluctuations and influences. In addition, adolescents need to develop good self-awareness to be able to apply their knowledge to the tasks of self-management. Education about diabetes and self-management is likely to be delivered at a time when an adolescent is newly diagnosed, and may not be well processed,

due to anxiety, distress, lack of acceptance and a difficulty in coming to terms with the diagnosis. Ongoing support to integrate knowledge, develop self-awareness and practice effective self-management might require more support for a longer time after diagnosis than is currently being provided, and SweetSpot could assist that.

One participant did not like SweetSpot.

> It's just rubbish…..It's just not very good. (Alison)

Struggling verses not struggling

Many participants stated they do not struggle with their diabetes.

> Honestly? It's like no different to just not having diabetes anymore…. It has no effect on me at all. (Hamish)

Some participants feel frustrated their struggles are not discussed at appointments and high expectations are placed on them.

> I come to one of the recent appointments and one of the doctors reminded me, you can have future implications. And I was like, I do come to these appointments and we just kind of discuss, and everything's all like fluffy and airy. Erm, it's like well we'll change this and see how it goes, and three months after nothing's really changed. It's just frustrating. I'm wanting the best for my future, and I'm not someone who's just gonna like fart about and not bother doing anything. Because I do try. But it's almost like, when I try harder the more I'm like aware that nothing's working. It's almost like, I'm not getting anywhere. It's frustrating. (Lilly)

This makes them feel like their efforts are disregarded, stigmatised and hopeless about their future.

Disengagement

It seemed that if participants feel messages conveyed are unrepresentative, repetitive, or are not fully understood they disengage with the process and are less likely to make changes.

> Umm, there's just lots of big blocks of text, how *some* people feel… Like, you telling the app how *you* feel. Rather than it telling you, how you might feel. (Alison)

> Ummm, probably a bit more, like, you input your own answers. And then maybe like having, instead of just one choice. Maybe having a couple more, about maybe expanding why. (Helen)

This suggests that adolescents do not feel listened to, and frustrated that people do not understand their experience. This could be representative of how adolescents respond at their appointments and is something participants seemed to wish to overcome. Later chapters of SweetSpot did interact in this way, but it appears that by not introducing these personalised elements early on in the journey, some of the participants may have felt lectured about their diabetes, rather than SweetSpot being a form of interactive support. Within apps it is difficult to translate concepts that might be successfully used clinically, so they can be clearly delivered independent of a therapist. It appears that some psychological interventions were not effectively delivered within SweetSpot.

> I used it every day for I think a week to two weeks and then exams started so I didn't have time (Hamish)

It also seemed that participant's prioritised other things over using SweetSpot. Young people might prioritise other things over diabetes management.

How diabetes impacts me and how this could potentially be addressed in an app

Although participants feel they manage their diabetes well and are generally accepting of the condition, there are still psychological struggles they find difficult at times.

Always on your mind

Some adolescents seemed to be in distress and showed frustration with trying to cope with TD1. This results in them trying to control or avoid these difficult experiences whilst felling trapped and uncertain about how to cope.

> That's why I try and push it away, and I hate talking to people about it…I'm trying not to cry, and trying not to get upset... I don't know if it's better to push it away, or to realise it and try and make it better. (Lilly)

There was a sense that self-reflection could be helpful.

> I done the exercise thing as well, and it was pretty helpful. You know where you could errr, how good you were feeling throughout the day with your diabetes, reflecting on the day how you felt. Gave you confidence and that. (Joe)

SweetSpot aimed to help participant's track and monitor their behaviour which would increase self-reflection. This then needs to be translated into behaviour change in participants, and it is clear that these aspects need to be further developed to encourage this change to encourage young people to live a value driven life.

Controls life

Adolescents appeared frustrated with the constraints diabetes puts on their life.

> There's no up unless you get it under control, and when you have it under control, it's like you feel like you're not actually living your life...Like the whole thing [SweetSpot] made me sort of realise this is important…and I think the app was sort of, maybe because it's supposed to be daily, it's more of a reminder, why don't you try and push yourself, why don't you try and get it under control. (Lilly)

> I would say I get, coz, like, coz if there's something you personally want, like a certain job and that, but you're not allowed for diabetes, that can be. It can be really destroying at times, and it can make you really angry. Like a lot, coz it's, that's how I feel, coz it's, coz it just makes me angry that I can't do what I want. Coz diabetes is a limitation….Coz I wanted to join the army, but I couldn't because of diabetes. Can't even join the TA or the other branches of the forces. (Rory)

Some adolescents seemed discouraged about these constraints and the course their life has had to take. Others appeared angry that they are controlled by diabetes and feel helpless, but found that SweetSpot reinvigorated their efforts. SweetSpot aimed to increase willingness in living a valued life with diabetes. It was apparent that more development is needed in SweetSpot so young people access more of SweetSpot's content to determine whether it is effective in targeting the ACT processes and making change.

Seeing yourself as different can create stigma or embarrassment

It appears that these adolescents can feel segregated and stigmatised through living with TD1. Negative societal messages in the media could be influencing how adolescents experience TD1. This might mean participant's try to avoid thinking about these comparisons made by others. Some adolescents felt that the main messages in society are about TD2, and that TD1 is often not recognised.

> So if you think other people are going to judge you for it, you are gonna try and hide it. But if your, you get on with it, that's the main thing…It's just, you can't help it, so. No one's gonna like judge you for it. They're not really a friend if they do. Shouldn't hang around with them anyway. People, like aren't going to judge you for it. (Finley)

> I think nobody knows what type 1 is, but now that type 2's come out, it's kinda been in the news a few times and they've been explaining it and that a bit. That's never really happened to type 1 that I've saw anyway.
> Interviewer: Do you think that has an impact on you living with a different type of diabetes? No, coz I know what type I've got, I know that I'm not type 2 and it's not to do with my diet, and it's just in my DNA and all that I think. So, ummm, I'm different from type 2 in a way. (Joe)

This could further indicate that they do not feel heard by those around them and how SweetSpot could bridge this gap.

> I think as well, like with the app it can like bring people that are all diabetic closer coz you are all using it, so it would be like a good thing for communicating, and finding out like other people's stuff, and stuff like that. Can help each other. (Freya)

If SweetSpot is able to bridge this gap it could empower young people to live a valued life with diabetes.

Having support

Adolescents wanted input from those encountering similar life experiences, which might install hope and connectedness. Adolescents seemed to want to feel empowered in their self-management with the support of professionals, rather than professionals providing all the answers without their input.

> If you just went to clinic and like and stuff and then make sure you took in what the doctor said, and ask them whatever they had to say, they'd probably find out what they need to…Or having an app like that but with frequently asked questions as a section. Or being able to ask other people who've like sort of certified to have had. To sort of have some expertise in the area. (Hamish)

> Yeah it was pretty straight forward, so it wasn't difficult or nothing, and errr you could see like how spread out your numbers and that were. So you could see where you could fix it. How much insulin you could, you need to take in other areas and that. Like when you come in here to see a Dr you could like, you could have showed them, and they would have been like, oh yeah you could improve here and that. But it's pretty helpful. (Joe)

SweetSpot could be used to track and bring behaviour that is happening outside, into the consultation room thus helping improve relationships with services. It seemed that adolescents continuously have questions regarding living with diabetes, and they identified how SweetSpot could aid this through the use of the self-monitoring, tracking features, information, frequently asked questions, direct social support (chat rooms). These could be combined with a live health professional approach.

Participant's made suggestions for improvement which included having SweetSpot on their smartphones, simplification, more visual information, ability to divide the monitoring graphs into subsections, making some features more interactive. Further information can be found in supplementary online material (appendix 3).

Discussion

Summary

This is the first ACT based app designed for adolescents with TD1 that incorporates ACT and Mindfulness strategies into living well with diabetes. Overall, findings suggest that it was seen as acceptable and helpful to adolescents. However it does not fully represent adolescent's experiences of living with TD1. It highlights how there are a range of experiences of living with this condition, and how apps might not be able to represent all experiences. Information in the app about potential difficulties living with TD1 was based on previous literature (Borus & Laffel, 2010; Karlsson et al., 2008). The aim of this was to normalise these difficulties, but some participants appeared to find it alienating. Participants suggested inputting their own experiences and for SweetSpot to respond to these, which is a feature of SweetSpot in later

chapters. This highlights the need to build in features that introduce interactivity from the start or to encourage participants to work through all the content.

One way adolescents seemed to cope with difficulties was by attempting to avoid or control them. SweetSpot provides participants with a self-monitoring tool that appeared to help some participants take responsibility for tracking what they were doing, monitoring their physical condition (i.e. blood glucose readings) and helped them to develop greater self-awareness of their management. SweetSpot was designed to provide an accessible method for accurate diabetes related information that is readily available to adolescents, help them self-monitor and develop greater psychological flexibility to engage in diabetes self-care, pursue self-chosen values, with greater openness. It appeared however that there were some barriers to adolescents accessing these features.

Limitations and Strengths

The main limitation of this research, was that the ACT elements incorporated in SweetSpot could not be fully evaluated, as a number of participants disengaged from using SweetSpot prior to accessing and using the ACT content. This is an essential feature to be incorporated into the redesign of SweetSpot. Also participants were using borrowed devices due to difficulties with recruitment when asking participants to download SweetSpot onto their smartphones. If they had been using it on their own phone, their experiences of using SweetSpot may have been different. Even though purposive sampling was used, there may have been sampling bias in those who were willing to take part in the study to those who were not.

Another limitation was that interviews and recruitment both took place at hospital sites. This could have biased some responses, as participants may have thought the interviewer (EB) might report back their individual responses to their diabetes team. Participants could have been providing socially desirable answers due to knowing the interviewer was involved in SweetSpot's development. As lead researcher, the interviewer also analysed the data and it is possible that her interpretations of what the participants were saying could have been biased. In contrast, a number of features were built into the research to ensure this was less likely such as using methods of triangulation, continual self-reflection throughout analysis, and taking an open non-judgemental approach throughout interviews. This is why it was paramount to be transparent throughout the analytic process.

The main strengths of this study were that it was grounded in participant's actual experiences of using SweetSpot, it was direct, clear, transparent, and not over interpreted. The findings have high practical utility in terms of app development which secures the voice of adolescents with diabetes into the development of treatment. This is likely to enhance its applicability, utility and effectiveness in future studies.

Implications for Theory

One reason for adolescents disengaging was due to prioritising other commitments. Adherence to self-care regimes are reduced in adolescents (Hamilton & Daneman, 2002; Pai & Ostendorf, 2011). This could be in part due to cognitive maturity. Around this time there is a cognitive transition from concrete to abstract thinking styles (Piaget, 1964; Piaget, 2008). Young teenagers find it difficult to fully appreciate long-term consequences. Later adolescence is when hypothetical thinking styles operate. These are difficult at times of stress, such as illness. Adolescents might revert to more egocentric thinking, making them feel safe from long-term consequences (Taddeo, Egedy, & Frappier, 2008). One way to reinforce the importance of prioritising long-term health is to build further workability aspects into SweetSpot, as are typically incorporated into ACT interventions. Workability interventions involve contrasting the short-term and long-term consequences of responding in particular ways, to highlight choices and the influence of consequences on behaviour. SweetSpot could aid to contact such contingencies and thereby commit to making change. As cognitive maturity might be an issue in making decisions, supporting adolescents with this is important (Viklund & Wikblad, 2009). SweetSpot could help participants slow down, have a place to gather clear information, clearly see the consequences and therefore make decisions.

Adolescent's likelihood to disengage could be because the probability to use avoidance with diabetes-related stimuli was high. For example, fears of fitting in meant that some participants tried to hide their struggles due to stigma or embarrassment (Borus & Laffel, 2010; Karlsson, Arman, & Wikblad, 2008). Other participants try to control or avoid these 'private events' to try and make them less distressing. High levels of cognitive fusion and experiential avoidance has been associated with adverse outcomes (Greco et al., 2008). Adolescents that are likely to avoid diabetes-related thoughts, feelings and actions are less likely to adhere to treatment regimens (Hadlandsmyth, White, Nesin, & Greco, 2013). This indicates the need to normalise these feelings, and an ACT based app would seem appropriate to help adolescents to accept these 'private events', to help re-engage with their values without being trapped in these psychological battles. It might be helpful to use component analysis to determine whether

targeting avoidance early in treatment would reduce the likelihood of disengagement. However, it might be that disengagement is typical adolescent behaviour and so creating treatments which are engaging throughout would be useful.

Implications for Future App Development

Similar to previous research, participants did not fully engage with the ACT content. Levin, Hayes, Pistorello, & Seeley (2016) found university students engaged more with a mental health education online programme than an ACT based one. This current study highlighted that some adolescents did not feel SweetSpot represented their experiences of living with TD1, suggesting that SweetSpot must become more sophisticated to target content according to need. Perhaps those that are already flexible and managing quite well might only need some elements. It could be useful for developers to consider the optimum delivery of components based upon a self-assessment in the app. For example: Patients could click on 'I am generally accepting of my diabetes' or 'I feel I am managing pretty well' and they go through one set of content, but if they click on 'I hide my diabetes from other people' or 'I avoid measuring my glucose to avoid feeling like I am failing' they go on a different journey though the app.

Those participants that engaged with SweetSpot throughout the study period identified goals to work on. If values were incorporated earlier (currently module three) it might help people identify goals to work on, which appears to engage adolescents in using SweetSpot more. It could mean that adolescents are more focused when using SweetSpot, which might impact on the effectiveness of the intervention. Adolescents also suggested that having support from others was beneficial, so incorporating a social support aspect into the app might be helpful. For example, linking SweetSpot to an online diabetes community which provides information through peers and experts in the field, having frequently asked questions, having testimonials by people with lived experiences, and a link to an online forum through SweetSpot.

Participants did not understand some aspects of SweetSpot. This indicates that more consideration needs to go into making the main content clearer, incorporating greater structure to walk the user through the intervention, exactly as a live therapist might. In addition, some participants wanted more personalised feedback and felt the look and feel of the app could be made to be more appealing. This is supported by a review looking at ACT delivered through technology, which found that users of ACT based technologies preferred simplicity, mobility, short easy exercises, reminders, immediate feedback, and variation of questions (Barker, Randell & Gillanders, submitted). Incorporating more of these aspects would be important in

future app development. Additionally, having different platforms for different age groups, and providing choice over the aesthetics of SweetSpot could be helpful.

Implications for Clinical Practice

Participants recognised that there is a link between physical and mental health and appeared to want this as a part of their usual treatment. The aim of SweetSpot is not to replace existing care, but often there is limited time for psychology support within diabetes teams. These types of apps could help adolescents manage their diabetes more independently. For example: participants generally liked the graphing feature, as it helped them to visualise their blood glucose control over time, helped them make decisions about management and how to improve it, and provided visual feedback of successful management. This is something participants seemed to value over what they currently experience at appointments. This could be a useful feature that patients could bring to appointments and discuss potential anomalies on their graph, or think about how to resolve ongoing difficulties with the support of the diabetes team. These apps could help adolescents who do not usually seek psychological support as a form of self-help to manage the day-to-day psychological struggles and could support people as part of an ongoing treatment plan. They could also enhance face-to-face therapy for those needing more in-depth support and could be used as a maintenance tool after therapy for diabetes related struggles.

Future Research

Using research methods such as these to determine users' experiences and preferences is an important step in ensuring that the technology used to deliver psychotherapy is optimised in its ability to deliver the psychotherapy components. Once optimised, further research can test the effectiveness of specific apps and of the psychological therapies delivered this way. Given the capacity of apps to track behaviour, input data form the user, interact in a programmed manner to user input and to monitor subsequent user responses, apps also have the potential not only to deliver psychological therapies, but to evaluate the specific components and principles that are incorporated into each therapy. This could give psychotherapy research using technology delivered therapies an advantage over traditional psychotherapy research.

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References

Adler, A. I., Boyko, E. J., Ahroni, J. H., Stensel, V., Forsberg, R. C., & Smith, D. G. (1997). Risk Factors for Diabetic Peripheral Sensory Neuropathy: Results of the Seattle Prospective Diabetic Foot Study. *Diabetes Care*, *20*(7), 1162–1167. http://doi.org/10.2337/diacare.20.7.1162

Ahtinen, A., Mattila, E., Välkkynen, P., Kaipainen, K., Vanhala, T., Ermes, M., … Lappalainen, R. (2013). Mobile mental wellness training for stress management: Feasibility and design implications based on a one-month field study. *Journal of Medical Internet Research*, *15*(7). Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84883413359&partnerID=40&md5=4189982e7d26eff698b823dfa349fd0c

American Diabetes Association. (2009). Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care*, *32*(Supplement_1), S62–S67. doi:10.2337/dc09-S062

Andrews, T. (2012). What is social constructionism. *Grounded theory review*,*11*(1), 39-46.

Barker, E., Randell, K., & Gillanders, D. (2016) *Acceptability, Utility and Effectiveness of using Technology to Deliver Acceptance and Commitment Therapy: A Systematic Review*. Manuscript submitted for publication.

Borus, J. S., & Laffel, L. (2010). Adherence challenges in the management of type 1 diabetes in adolescents: prevention and intervention: *Current Opinion in Pediatrics*, *22*(4), 405–411. http://doi.org/10.1097/MOP.0b013e32833a46a7

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. http://doi.org/10.1191/1478088706qp063oa

Carroll, A. E., DiMeglio, L. A., Stein, S., & Marrero, D. G. (2011). Using a Cell Phone-Based Glucose Monitoring System for Adolescent Diabetes Management. *The Diabetes Educator*, *37*(1), 59–66. http://doi.org/10.1177/0145721710387163

Cassell, C., & Symon, G. (Eds.). (2004). *Essential guide to qualitative methods in organizational research*. London ; Thousand Oaks: SAGE Publications.

Channon, S. (2005). Motivational Interviewing with Teenagers with Diabetes. *Clinical Child Psychology and Psychiatry*, *10*(1), 43–51. http://doi.org/10.1177/1359104505048790

Ciarrochi, J., & Bilich, L. (2006). Acceptance and Commitment Therapy. Measures Package. *Unpublished manuscript, University of Wollongong, Wollongong, Australia*.

Court, J. M., Cameron, F. J., Berg-Kelly, K., & Swift, P. G. (2009). Diabetes in adolescence. *Pediatric Diabetes*, *10*, 185–194. http://doi.org/10.1111/j.1399-5448.2009.00586.x

Daneman, D. (2006). Type 1 diabetes. *The Lancet*, *367*(9513), 847–858. http://doi.org/10.1016/S0140-6736(06)68341-4

Demidowich, A. P., Lu, K., Tamler, R., & Bloomgarden, Z. (2012). An evaluation of diabetes self-management applications for Android smartphones. *Journal of Telemedicine and Telecare*, *18*(4), 235–238. http://doi.org/10.1258/jtt.2012.111002

Diabetes UK (2013). *Rising rates of diabetes highlighted.* Accessed on 11.03.16. Retrieved from: http://www.diabetes.org.uk/About_us/News_Landing_Page/2007/October/Rising-rates-of-diabetes-highlighted/

Gale, N. K., Heath, G., Cameron, E., Rashid, S., & Redwood, S. (2013). Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Medical Research Methodology*, *13*(1), 117. http://doi.org/10.1186/1471-2288-13-117

Gergen, K. J. (2009). *Realities and relationships: Soundings in social construction*. Harvard University Press.

Greco, L. A., Lambert, W., & Baer, R. A. (2008). Psychological inflexibility in childhood and adolescence: Development and evaluation of the Avoidance and Fusion Questionnaire for Youth. *Psychological Assessment*, *20*(2), 93–102. http://doi.org/10.1037/1040-3590.20.2.93

Gregg, J, A., Almada, P., & Schmidt, E. (2011). Heath Behavior Problems in Diabetes, Obesity and Secondary Prevention. In McCracken, L, M,. (Ed), *Mindfulness & Acceptance in Behavioural Medicine.* Oakland. New Harbinger Publications Inc

Gregg, J. A., Callaghan, G. M., Hayes, S. C., & Glenn-Lawson, J. L. (2007). Improving diabetes self-management through acceptance, mindfulness, and values: A randomized controlled trial. *Journal of Consulting and Clinical Psychology*, *75*(2), 336–343. http://doi.org/10.1037/0022-006X.75.2.336

Hadlandsmyth, K., White, K. S., Nesin, A. E., & Greco, L. A. (2013). Proposing an Acceptance and Commitment Therapy Intervention to Promote Improved Diabetes Management in Adolescents: A Treatment Conceptualization. *Dyskinesia and comorbid Social Anxiety*, *7*(4), 12.

Hamilton, J., & Daneman, D. (2002). Deteriorating Diabetes Control during Adolescence: Physiological or Psychosocial? *Journal of Pediatric Endocrinology and Metabolism*, *15*(2). http://doi.org/10.1515/JPEM.2002.15.2.115

Hannes, K., Lockwood, C., & Pearson, A. (2010). A comparative analysis of three online appraisal instruments' ability to assess validity in qualitative research. *Qualitative Health Research*, *20*(12), 1736–1743. http://doi.org/10.1177/1049732310378656

Helgeson, V. S., Reynolds, K. A., Snyder, P. R., Palladino, D. K., Becker, D. J., Siminerio, L., & Escobar, O. (2013). Characterizing the transition from paediatric to adult care among emerging adults with Type 1 diabetes. *Diabetic Medicine*, *30*(5), 610–615. http://doi.org/10.1111/dme.12067

Hochhauser, C. J., Rapaport, R., Shemesh, E., Schmeidler, J., Chemtob, C. M. (2008). Age at diagnosis, gender, and metabolic control in children with type 1 diabetes. *Pediatr Diabetes* 9: 303-307.

Holloway, I., & Todres, L. (2003). The Status of Method: Flexibility, Consistency and Coherence. *Qualitative Research*, *3*(3), 345–357. http://doi.org/10.1177/1468794103033004

International Diabetes Federation (2014). Accessed on 31.3.16. Retrieved from: https://www.idf.org/sites/default/files/Atlas-poster-2014_EN.pdf

Iribarren, C., Karter, A. J., Go, A. S., Ferrara, A., Liu, J. Y., Sidney, S., & Selby, J. V. (2001). Glycemic Control and Heart Failure Among Adult Patients With Diabetes. *Circulation*, *103*(22), 2668–2673. http://doi.org/10.1161/01.CIR.103.22.2668

Karlsson, A., Arman, M., & Wikblad, K. (2008). Teenagers with type 1 diabetes—a phenomenological study of the transition towards autonomy in self-management. *International Journal of Nursing Studies*, *45*(4), 562–570. http://doi.org/10.1016/j.ijnurstu.2006.08.022

Lacey. A., & Luff. D., (2007). Qualitative Research Analysis. The NIHR RDS for the East Midlands / Yorkshire & the Humber. Accessed on 6.1.16 from: https://www.rds-yh.nihr.ac.uk/wp-

Levin, M. E., Hayes, S. C., Pistorello, J., & Seeley, J. R. (2016). Web-based self-help for preventing mental health problems in universities: Comparing acceptance and commitment training to mental health education. *Psychological & Physical Disorders.*

Long, A. F., Godfrey. M., Randall. T., Brettle, A. J., & Grant, M. J., (2002) *Developing Evidence Based Social Care Policy and Practice. Part 3: Feasibility of Undertaking Systematic Reviews in Social Care*. Leeds: Nuffield Institute for Health.

McCullough, P. A., Wolyn, R., Rocher, L. L., Levin, R. N., & O'Neill, W. W. (1997). Acute Renal Failure After Coronary Intervention. *The American Journal of Medicine*, *103*(5), 368–375. http://doi.org/10.1016/S0002-9343(97)00150-2

Nes, A. A. G., van Dulmen, S., Eide, E., Finset, A., Kristjánsdóttir, Ó. B., Steen, I. S., & Eide, H. (2012). The development and feasibility of a web-based intervention with diaries and situational feedback via smartphone to support self-management in patients with diabetes type 2. *Diabetes Research and Clinical Practice*, *97*(3), 385–393. http://doi.org/10.1016/j.diabres.2012.04.019

Newton, B. (2014). Development and evaluation of an online self-help program for perfectionism using cognitive therapy and acceptance concepts. [Health & Mental Health Treatment & Prevention [3300]]. Retrieved 1 January 1974, from http://gateway.proquest.com/openurl?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&res_dat=xri:pqm&rft_dat=xri:pqdiss:3562215

Pai, A., & Ostendorf, H. M. (2011). Treatment Adherence in Adolescents and Young Adults Affected by Chronic Illness During the Health Care Transition From Pediatric to Adult Health Care: A Literature Review. *Children's Health Care*, *40*(1), 16–33. http://doi.org/10.1080/02739615.2011.537934

Piaget, J. (1964). Part I: Cognitive development in children: Piaget development and learning. *Journal of research in science teaching*, *2*(3), 176-186.

Piaget, J. (2008). Intellectual Evolution from Adolescence to Adulthood. *Human Development*, *51*(1), 40–47. http://doi.org/10.1159/000112531

Renders, C. M., Valk, G. D., Griffin, S. J., Wagner, E. H., Eijk van, J. T., & Assendelft, W. J. J. (2001). Interventions to Improve the Management of Diabetes in Primary Care, Outpatient, and Community Settings: A systematic review. *Diabetes Care*, *24*(10), 1821–1833. http://doi.org/10.2337/diacare.24.10.1821

Richards, D. A., & Bower, P. (2011). Equity of access to psychological therapies. *The British Journal of Psychiatry*, *198*(2), 91–92. http://doi.org/10.1192/bjp.bp.110.083485

Ritchie, J., & Lewis, J. (Eds.). (2003). *Qualitative research practice: a guide for social science students and researchers*. London ; Thousand Oaks, Calif: Sage Publications.

Ritchie, J., Spencer, L., Bryman, A., & Burgess, R. G. (1994). Analysing qualitative data. *London: Routledge*, *3*.

Savage, E., Farrell, D., McManus, V., & Grey, M. (2010). The science of intervention development for type 1 diabetes in childhood: systematic review: Intervention development for childhood diabetes. *Journal of Advanced Nursing*, *66*(12), 2604–2619. http://doi.org/10.1111/j.1365-2648.2010.05423.x

Schwandt, T. A. (2000). Three epistemological stances for qualitative inquiry. *Handbook of qualitative research*, *2*, 189-213.

Singh, S. P. (2009). Transition of care from child to adult mental health services: the great divide: *Current Opinion in Psychiatry*, *22*(4), 386–390. http://doi.org/10.1097/YCO.0b013e32832c9221

Smith, J., & Firth, J. (2011). Qualitative data analysis: the framework approach. *Nurse Researcher*, *18*(2), 52–62. http://doi.org/10.7748/nr2011.01.18.2.52.c8284

Steinberg, L. (2005). Cognitive and affective development in adolescence. *Trends in Cognitive Sciences*, *9*(2), 69–74. http://doi.org/10.1016/j.tics.2004.12.005

Svensson, J., Lyngaae-Jørgensen, A., Carstensen, B., Simonsen, L. B., Mortensen, H. B., & Danish Childhood Diabetes Registry. (2009). Long-term trends in the incidence of type 1 diabetes in Denmark: the seasonal variation changes over time. *Pediatric Diabetes*, *10*(4), 248–254. http://doi.org/10.1111/j.1399-5448.2008.00483.x

Taddeo, D., Egedy, M., & Frappier, J. Y. (2008). Adherence to treatment in adolescents. *Paediatrics & child health*, *13*(1), 19-24.

Viklund, G., & Wikblad, K. (2009). Teenagers' perceptions of factors affecting decision-making competence in the management of type 1 diabetes: *Teenagers' perceptions of factors affecting decision-making competence*. *Journal of Clinical Nursing*, *18*(23), 3262–3270. http://doi.org/10.1111/j.1365-2702.2009.02963.x

Winkley, K. (2006). Psychological interventions to improve glycaemic control in patients with type 1 diabetes: systematic review and meta-analysis of randomised controlled trials. *BMJ*, *333*(7558), 65–0. http://doi.org/10.1136/bmj.38874.652569.55

Yardley, L. (2000). Dilemmas in qualitative health research. *Psychology & Health*, *15*(2), 215–228. http://doi.org/10.1080/08870440008400302

Supplementary Online Material

Appendix 1. Interview Schedule

1. How did you find using the app?
2. Did anything stand out when using the app?
3. What were some of the features you preferred?
4. What aspects were most useful? Why?
5. Did you find anything confusing or anything that didn't make sense when you used the app?
6. Did you come across any difficulties using the app?
7. What did you think about the different chapters in the app? What did they make you think about? How did you interact with them?
8. Were there any aspects you would change?
9. How easy was the app to use?
10. What did you think about the appearance of the app?
11. Do you think the app made you feel differently about your diabetes? In what way? How do you think the chapters linked with this?
12. Where were you most likely to use the app? Why do you think this was?
13. When were you most likely to use the app?
14. What improvements would you make?
15. How much did you use the app 0-100 (100 being all the time)
16. How satisfied were you with the app 0-100 (100 most satisfied)
17. What are your thoughts about health care delivered through apps?
18. What do you think about this: struggling to avoid discomfort or distress, sometimes makes it worse?
19. What do you think about whether people struggle with diabetes?
20. Can you explain a time where you have had any experience of that?
21. How would you hope people would interact with an app like this?
22. What's it like to have diabetes?
23. What do you think about the link between psychology and medical problems?
24. Where would you see psychology as playing a role in medical problems?

Appendix 2. Additional Methodology

As described in the main body of the article, EB's epistemological position is described as 'empathic neutrality'. From this perspective, research cannot be value free and findings are inevitably influenced by people's perspective (Richie & Lewis, 2003). This is why it is important for the researcher to be open, sensitive and respectful. It means that the assumptions and history of the researcher will guide what is considered to be 'the data' the units of meaning and analysis, the kinds of questions asked and the practices of interviewing. Each of these will shape the data itself and the analysis that kneads to the emergent themes. It is therefore important to continually reflect on these and to keep interpretations transparent to reduce the likelihood of bias. This was one of the reasons for choosing framework analysis. Framework analysis is a type of It is a type of thematic analysis which is often used when discovering the intricacies of health and wellbeing and can help create an in-depth understanding of the patient experience (Smith & Firth, 2011). The methods of thematic analysis are seen to be independent from epistemological stance (Braun & Clarke, 2006). Yet, it seems challenging for one to really be able to separate the analysis from their epistemological assumptions. This makes it even more important to state the position adopted throughout the analysis (Holloway, & Todres, 2003), to keep the interpretations transparent and reduce the likelihood of bias. The position of this study was socially constructed realism whereby the interviewer and interviewee might construct a joint version of 'reality' (Cassell, & Symon, 2004). This view proposes that the mind creates truth and does not discover it (Schwandt, 2003). The analysis of the 'minds creations' underlying the phenomena is needed to understand it (Gergen, 2009), and these creations correspond to something real in the world (Andrews, 2012). It proposes that participants were describing their own view about their own experience of living with diabetes, which has some shared social validity to others who have experienced living with diabetes. This is another reason for using framework analysis as it considers populations that have shared commonalities, yet may have some different opinions and experiences regarding these (Ritchie, & Lewis, 2003). In this study all participants had lived with TD1 and they may share common experiences, yet participants may have similar or opposing views about delivery of healthcare via technology, their experiences of living with TD1, or of using the app.

Appendix 3: Recommendations to Improve SweetSpot

What I would want from an app like this

Participants identified other things they want from SweetSpot and ways to make it more appealing to them.

Portability

Participants indicated that they would be more likely to use SweetSpot regularly if it was on their personal smartphone.

> Errrr, because you know errr, it would be easier to log it because you've got like. Since it's an app, you'll probably have it on your phone, you have it everywhere you go, so you could just put your reading in there and then. Rather than having to think back to when you actually done it, if you were writing it down in a diary or something.
>
> (Joe)

The need for more interaction

Generally participants saw the utility in SweetSpot, but there were certain features which needed to be more interactive in order to get the most out of them.

> Well my plan was I was going to put in all my readings at night time from the whole day, but when you put the readings in, I don't think you can like insert the time. (Finley)

Preference for visuals

Participant's suggested including more clips, more colour, and the ability to break down graphs into subsections they wanted to look at in more detail.

> If that was me, I'd make it more like. I'd think I'd more use it if it was more like colourful. Or a bit more for my age group. It's quite plain how it is. I don't know, colour background or stuff like that. Brighten it up a bit...Like, maybe like pictures, or like coz the app itself didn't really like have pictures.
>
> (Freya)

> Errr, I think the graph's good…. If you could create a new graph, I don't. It could like have separate graphs…So like take a sub bit of the graph so I can take a closer look at it, or something like that?
>
> (Finley)

Full Reference List

Adler, A. I., Boyko, E. J., Ahroni, J. H., Stensel, V., Forsberg, R. C., & Smith, D. G. (1997). Risk factors for diabetic peripheral sensory neuropathy. Results of the Seattle Prospective Diabetic Foot Study. *Diabetes Care*, *20*(7), 1162–1167. http://doi.org/10.2337/diacare.20.7.1162

Ahtinen, A., Mattila, E., Välkkynen, P., Kaipainen, K., Vanhala, T., Ermes, M., … Lappalainen, R. (2013). Mobile mental wellness training for stress management: Feasibility and design implications based on a one-month field study. *Journal of Medical Internet Research*, *15*(7). Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84883413359&partnerID=40&md5=4189982e7d26eff698b823dfa349fd0c

American Diabetes Association. (2009). Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care*, *32*(Supplement_1), S62–S67. doi:10.2337/dc09-S062

Andrews, T. (2012). What is social constructionism. *Grounded theory review*,*11*(1), 39-46.

Australian Government (2010). The Department of Health: The Better Access Initiative. Assed on 19.1.15 from http://www.health.gov.au/internet/publications/publishing.nsf/Content/mental-ba-eval-dexec-toc~mental-ba-eval-dexec-bet

Barker & Gillanders (2015). Efficacy, feasibility and utility of using technology to deliver acceptance and commitment therapy: a systematic review. PROSPERO 2015:CRD42015020419 Available fromhttp://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42015020419

Barker, E., Randell, K., & Gillanders, D. (2016) *Acceptability, Utility and Effectiveness of using Technology to Deliver Acceptance and Commitment Therapy: A Systematic Review*. Manuscript submitted for publication.

Baumeister, H., Reichler, L., Munzinger, M., & Lin, J. (2014). The impact of guidance on Internet-based mental health interventions — A systematic review. *Internet Interventions*, *1*(4), 205–215. http://doi.org/10.1016/j.invent.2014.08.003

Block-Lerner, J., Wulfert, E., & Moses, E. (2009). ACT in Context: An Exploration of Experiential Acceptance. *Cognitive and Behavioral Practice*, *16*(4), 443–456. http://doi.org/10.1016/j.cbpra.2009.04.005

Borenstein, M. (Ed.). (2009). *Introduction to meta-analysis*. Chichester, U.K: John Wiley & Sons.

Borus, J. S., & Laffel, L. (2010). Adherence challenges in the management of type 1 diabetes in adolescents: prevention and intervention: *Current Opinion in Pediatrics*, *22*(4), 405–411. http://doi.org/10.1097/MOP.0b013e32833a46a7

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. http://doi.org/10.1191/1478088706qp063oa

Bricker, J. B., Mull, K. E., Kientz, J. A., Vilardaga, R., Mercer, L. D., Akioka, K. J., & Heffner, J. L. (2014). Randomized, controlled pilot trial of a smartphone app for smoking cessation using acceptance and commitment therapy. *Drug and Alcohol Dependence*, *143*, 87–94. http://doi.org/10.1016/j.drugalcdep.2014.07.006

Bricker, J., Wyszynski, C., Comstock, B., & Heffner, J. L. (2013). Pilot Randomized Controlled Trial of Web-Based Acceptance and Commitment Therapy for Smoking Cessation. *Nicotine & Tobacco Research*, *15*(10), 1756–1764. http://doi.org/10.1093/ntr/ntt056

Buhrman, M., Skoglund, A., Husell, J., Bergström, K., Gordh, T., Hursti, T., … Andersson, G. (2013). Guided internet-delivered acceptance and commitment therapy for chronic pain patients: A randomized controlled trial. *Behaviour Research and Therapy*, *51*(6), 307–315. http://doi.org/10.1016/j.brat.2013.02.010

Button, K. S., Ioannidis, J. P. A., Mokrysz, C., Nosek, B. A., Flint, J., Robinson, E. S. J., & Munafò, M. R. (2013). Power failure: why small sample size undermines the reliability of neuroscience. *Nature Reviews Neuroscience*, *14*(5), 365–376. http://doi.org/10.1038/nrn3475

Carlbring, P., Hägglund, M., Luthström, A., Dahlin, M., Kadowaki, Å., Vernmark, K., & Andersson, G. (2013). Internet-based behavioral activation and acceptance-based treatment for depression: A randomized controlled trial. *Journal of Affective Disorders*, *148*(2-3), 331–337. http://doi.org/10.1016/j.jad.2012.12.020

Carroll, A. E., DiMeglio, L. A., Stein, S., & Marrero, D. G. (2011). Using a Cell Phone-Based Glucose Monitoring System for Adolescent Diabetes Management. *The Diabetes Educator*, *37*(1), 59–66. http://doi.org/10.1177/0145721710387163

Cassell, C., & Symon, G. (Eds.). (2004). *Essential guide to qualitative methods in organizational research*. London ; Thousand Oaks: SAGE Publications.

Channon, S. (2005). Motivational Interviewing with Teenagers with Diabetes. *Clinical Child Psychology and Psychiatry*, *10*(1), 43–51. http://doi.org/10.1177/1359104505048790

Chase, J. A., Houmanfar, R., Hayes, S. C., Ward, T. A., Vilardaga, J. P., & Follette, V. (2013). Values are not just goals: Online ACT-based values training adds to goal setting in

improving undergraduate college student performance. *Journal of Contextual Behavioral Science*, *2*(3-4), 79–84.

Chorpita, B. F., Weisz, J. R., Daleiden, E. L., Schoenwald, S. K., Palinkas, L. A., Miranda, J., … Research Network on Youth Mental Health. (2013). Long-term outcomes for the Child STEPs randomized effectiveness trial: A comparison of modular and standard treatment designs with usual care. *Journal of Consulting and Clinical Psychology*, *81*(6), 999–1009. http://doi.org/10.1037/a0034200

Ciarrochi, J., & Bilich, L. (2006). Acceptance and Commitment Therapy. Measures Package. *Unpublished manuscript, University of Wollongong, Wollongong, Australia*.

Court, J. M., Cameron, F. J., Berg-Kelly, K., & Swift, P. G. (2009a). Diabetes in adolescence. *Pediatric Diabetes*, *10*, 185–194. http://doi.org/10.1111/j.1399-5448.2009.00586.x

Cuijpers, P., van Straten, A., & Andersson, G. (2008). Internet-administered cognitive behavior therapy for health problems: a systematic review. Journal of behavioral medicine, 31(2), 169-177.

Dahlin, M., Andersson, G., Magnusson, K., Johansson, T., Sjögren, J., Håkansson, A., … Carlbring, P. (2016). Internet-delivered acceptance-based behaviour therapy for generalized anxiety disorder: A randomized controlled trial. *Behaviour Research and Therapy*, *77*, 86–95. http://doi.org/10.1016/j.brat.2015.12.007

Daneman, D. (2006). Type 1 diabetes. *The Lancet*, *367*(9513), 847–858. http://doi.org/10.1016/S0140-6736(06)68341-4

Demidowich, A. P., Lu, K., Tamler, R., & Bloomgarden, Z. (2012). An evaluation of diabetes self-management applications for Android smartphones. *Journal of Telemedicine and Telecare*, *18*(4), 235–238. http://doi.org/10.1258/jtt.2012.111002

Diabetes UK (2013). *Rising rates of diabetes highlighted.* Accessed on 11.03.16. Retrieved from: http://www.diabetes.org.uk/About_us/News_Landing_Page/2007/October/Rising-rates-of-diabetes-highlighted/

Donagh. J., (2012). Breaking the Silence in Rural Areas: Rural Mental Health, Stigma, Services and Supports within the SWARD Region. Accessed on 10.12.15 from: http://www.niamhlouisefoundation.com/wp-content/uploads/2010/12/the_niamh_louise_foundation_breaking_the_silence_in_rural_areas_research_2012__sward___1_.pdf

Donker, T., Petrie, K., Proudfoot, J., Clarke, J., Birch, M.-R., & Christensen, H. (2013). Smartphones for Smarter Delivery of Mental Health Programs: A Systematic Review. *Journal of Medical Internet Research*, *15*(11), e247. http://doi.org/10.2196/jmir.2791

Dunst, C. J., Hamby, D. W., & Trivette, C. M., (2004). Guidelines for Caluculating Effect Sizes for Practice-Based Research Synthesis. *Centerscope: Evidence-Based Approaches to Early Childhood Development*, 3(1), 1-9.Durlak, J. A. (2009). How to Select, Calculate, and Interpret Effect Sizes. *Journal of Pediatric Psychology*, *34*(9), 917–928. http://doi.org/10.1093/jpepsy/jsp004

Durlak, J. A. (2009). How to select, calculate, and interpret effect sizes.*Journal of pediatric psychology*, jsp004.

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*,*39*, 175-191.

Free, C., Phillips, G., Galli, L., Watson, L., Felix, L., Edwards, P., … Haines, A. (2013). The Effectiveness of Mobile-Health Technology-Based Health Behaviour Change or Disease Management Interventions for Health Care Consumers: A Systematic Review. *PLoS Medicine*, *10*(1), e1001362. http://doi.org/10.1371/journal.pmed.1001362

Gale, N. K., Heath, G., Cameron, E., Rashid, S., & Redwood, S. (2013). Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Medical Research Methodology*, *13*(1), 117. http://doi.org/10.1186/1471-2288-13-117

Gergen, K. J. (2009). *Realities and relationships: Soundings in social construction*. Harvard University Press.

Greco, L. A., Lambert, W., & Baer, R. A. (2008). Psychological inflexibility in childhood and adolescence: Development and evaluation of the Avoidance and Fusion Questionnaire for Youth. *Psychological Assessment*, *20*(2), 93–102. http://doi.org/10.1037/1040-3590.20.2.93

Gregg, J, A., Almada, P., & Schmidt, E. (2011). Heath Behavior Problems in Diabetes, Obesity and Secondary Prevention. In McCracken, L, M,. (Ed), *Mindfulness & Acceptance in Behavioural Medicine*. Oakland. New Harbinger Publications Inc

Gregg, J. A., Callaghan, G. M., Hayes, S. C., & Glenn-Lawson, J. L. (2007). Improving diabetes self-management through acceptance, mindfulness, and values: A randomized controlled trial. *Journal of Consulting and Clinical Psychology*, *75*(2), 336–343. http://doi.org/10.1037/0022-006X.75.2.336

Hadlandsmyth, K., White, K. S., Nesin, A. E., & Greco, L. A. (2013). Proposing an Acceptance and Commitment Therapy Intervention to Promote Improved Diabetes

Management in Adolescents: A Treatment Conceptualization. *Dyskinesia and comorbid Social Anxiety*, *7*(4), 12.

Hamilton, J., & Daneman, D. (2002). Deteriorating Diabetes Control during Adolescence: Physiological or Psychosocial? *Journal of Pediatric Endocrinology and Metabolism*, *15*(2). http://doi.org/10.1515/JPEM.2002.15.2.115

Hannes, K., Lockwood, C., & Pearson, A. (2010). A comparative analysis of three online appraisal instruments' ability to assess validity in qualitative research. *Qualitative Health Research*, *20*(12), 1736–1743. http://doi.org/10.1177/1049732310378656

Hayes, S. C., Bissett, R., Korn, Z., Zettle, R. D., Rosenfarb, I., Cooper, L., & Grundt, A. (1999). The impact of acceptance versus control rationales on pain tolerance. *The Psychological Record*, *49*(1), 33-47.

Hayes, S. C., Luoma, J. B., Bond, F. W., Masuda, A., & Lillis, J. (2006). Acceptance and commitment therapy: model, processes and outcomes. *Behaviour Research and Therapy*, *44*(1), 1–25. http://doi.org/10.1016/j.brat.2005.06.006

Hayes, S. C., & Smith, S. (2005). *Get out of your mind & into your life: the new acceptance & commitment therapy* (Nachdr.). Oakland, Calif: New Harbinger Publ.

Hayes, S.C, Strosahl, K.D., & Wilson, K.G. (2012). *Acceptance and commitment therapy: The process and practice of mindful change* (2nd edition). New York, NY: The Guilford Press.

Hayes, S. C., Villatte, M., Levin, M., & Hildebrandt, M. (2011). Open, Aware, and Active: Contextual Approaches as an Emerging Trend in the Behavioral and Cognitive Therapies. *Annual Review of Clinical Psychology*, *7*(1), 141–168. http://doi.org/10.1146/annurev-clinpsy-032210-104449

Hedman, E., Ljótsson, B., & Lindefors, N. (2012). Cognitive behavior therapy via the Internet: a systematic review of applications, clinical efficacy and cost–effectiveness. *Expert Review of Pharmacoeconomics & Outcomes Research*, *12*(6), 745–764. http://doi.org/10.1586/erp.12.67

Helgeson, V. S., Reynolds, K. A., Snyder, P. R., Palladino, D. K., Becker, D. J., Siminerio, L., & Escobar, O. (2013). Characterizing the transition from paediatric to adult care among emerging adults with Type 1 diabetes. *Diabetic Medicine*, *30*(5), 610–615. http://doi.org/10.1111/dme.12067

Hesser, H., Gustafsson, T., Lundén, C., Henrikson, O., Fattahi, K., Johnsson, E., … Andersson, G. (2012). A randomized controlled trial of internet-delivered cognitive behavior therapy and acceptance and commitment therapy in the treatment of tinnitus. *Journal*

of Consulting and Clinical Psychology, *80*(4), 649–661. http://doi.org/10.1037/a0027021

Hesser, H., Westin, V. Z., & Andersson, G. (2014). Acceptance as a mediator in internet-delivered acceptance and commitment therapy and cognitive behavior therapy for tinnitus. [Cognitive Therapy [3311]].

Higgins, J. P. T., Green, S., & Cochrane Collaboration (Eds.). (2008). *Cochrane handbook for systematic reviews of interventions*. Chichester, England ; Hoboken, NJ: Wiley-Blackwell.

Hochhauser, C. J., Rapaport, R., Shemesh, E., Schmeidler, J., Chemtob, C. M. (2008). Age at diagnosis, gender, and metabolic control in children with type 1 diabetes. *Pediatr Diabetes* 9: 303-307.

Holloway, I., & Todres, L. (2003). The Status of Method: Flexibility, Consistency and Coherence. *Qualitative Research*, *3*(3), 345–357. http://doi.org/10.1177/1468794103033004

Hofmann, S., Sawyer, A., Witt, A., & Oh, D. (2010). The Effect of Mindfulness-Based Therapy on Anxiety and Depression: A Meta-Analytic Review.

Holloway, I., & Todres, L. (2003). The Status of Method: Flexibility, Consistency and Coherence. *Qualitative Research*, *3*(3), 345–357. http://doi.org/10.1177/1468794103033004

International Diabetes Federation (2014). Accessed on 31.3.16. Retrieved from: https://www.idf.org/sites/default/files/Atlas-poster-2014_EN.pdf

Iribarren, C., Karter, A. J., Go, A. S., Ferrara, A., Liu, J. Y., Sidney, S., & Selby, J. V. (2001). Glycemic Control and Heart Failure Among Adult Patients With Diabetes. *Circulation*, *103*(22), 2668–2673. http://doi.org/10.1161/01.CIR.103.22.2668

Jones, H. A., Heffner, J. L., Mercer, L., Wyszynski, C. M., Vilardaga, R., & Bricker, J. B. (2015). Web-based acceptance and commitment therapy smoking cessation treatment for smokers with depressive symptoms. [Psychotherapy & Psychotherapeutic Counseling [3310]]. Retrieved 4 January 2002, from

Karlsson, A., Arman, M., & Wikblad, K. (2008). Teenagers with type 1 diabetes—a phenomenological study of the transition towards autonomy in self-management. *International Journal of Nursing Studies*, *45*(4), 562–570. http://doi.org/10.1016/j.ijnurstu.2006.08.022

Lacey. A., & Luff. D., (2007). Qualitative Research Analysis. The NIHR RDS for the East Midlands / Yorkshire & the Humber. Accessed on 6.1.16 from: https://www.rds-yh.nihr.ac.uk/wp-

Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: a practical primer for t-tests and ANOVAs. *Frontiers in Psychology, 4*. http://doi.org/10.3389/fpsyg.2013.00863

Lappalainen, P., Granlund, A., Siltanen, S., Ahonen, S., Vitikainen, M., Tolvanen, A., & Lappalainen, R. (2014). ACT Internet-based vs face-to-face? A randomized controlled trial of two ways to deliver Acceptance and Commitment Therapy for depressive symptoms: An 18-month follow-up. *Behaviour Research and Therapy, 61*, 43–54. http://doi.org/10.1016/j.brat.2014.07.006

Levin, E. M., & Hayes, S. C., (2013). Evaluating a Prototype Acceptance and Commitment Training Web-Based Prevention Program for Depression and Anxiety in College Students (Unpublished Doctoral Dissertation). University of Nevada, Reno.

Levin, M. E., Hayes, S. C., Pistorello, J., & Seeley, J. R. (2016). Web-based self-help for preventing mental health problems in universities: Comparing acceptance and commitment training to mental health education. *Psychological & Physical Disorders.*

Levin, M. E., Pistorello, J., Seeley, J. R., & Hayes, S. C. (2014). Feasibility of a Prototype Web-Based Acceptance and Commitment Therapy Prevention Program for College Students. *Journal of American College Health*, *62*(1), 20–30. http://doi.org/10.1080/07448481.2013.843533

Lin & Lüking, (unpublished). Efficacy and Cost-Effectiveness of a Guided and Unguided Online-Based Acceptance and Commitment Therapy for Chronic Pain: a Three-Armed Randomized Controlled Trial. Accessed on 19.1.16 from https://contextualscience.org/wc13_symposia_detail

Ljotsson, B., Atterlof, E., Lagerlof, M., Andersson, E., Jernelov, S., Hedman, E., … Wicksell, R. K. (2014). Internet-delivered acceptance and values-based exposure treatment for fibromyalgia: A pilot study. *Behavioral & Psychological Treatment of Physical Illness.*

Long, A. F., Godfrey. M., Randall. T., Brettle, A. J., & Grant, M. J., (2002) *Developing Evidence Based Social Care Policy and Practice. Part 3: Feasibility of Undertaking Systematic Reviews in Social Care*. Leeds: Nuffield Institute for Health.

Luxton, D. D., McCann, R. A., Bush, N. E., Mishkind, M. C., & Reger, G. M. (2011). mHealth for mental health: Integrating smartphone technology in behavioral healthcare. *Professional Psychology: Research and Practice*, *42*(6), 505–512. http://doi.org/10.1037/a0024485

Ly K.H., Asplund K., & Andersson G. (2014). Stress management for middle managers via an acceptance and commitment-based smartphone application: A randomized

controlled trial. Retrieved from http://www.journals.elsevier.com/internet-interventions/

Ly, K. H., Dahl, J. A., Carlbring, P., & Andersson, G. (2012). Development and initial evaluation of a smartphone application based on acceptance and commitment therapy. *SpringerPlus, 1*(1), 1–11.

McCullough, P. A., Wolyn, R., Rocher, L. L., Levin, R. N., & O'Neill, W. W. (1997). Acute Renal Failure After Coronary Intervention. *The American Journal of Medicine, 103*(5), 368–375. http://doi.org/10.1016/S0002-9343(97)00150-2

Murray, G., Leitan, N. D., Berk, M., Thomas, N., Michalak, E., Berk, L., … Kyrios, M. (2015). Online mindfulness-based intervention for late-stage bipolar disorder: pilot evidence for feasibility and effectiveness. *Journal of Affective Disorders, 178*, 46–51. http://doi.org/10.1016/j.jad.2015.02.024

Nes, A. A. G., van Dulmen, S., Eide, E., Finset, A., Kristjánsdóttir, Ó. B., Steen, I. S., & Eide, H. (2012). The development and feasibility of a web-based intervention with diaries and situational feedback via smartphone to support self-management in patients with diabetes type 2. *Diabetes Research and Clinical Practice, 97*(3), 385–393. http://doi.org/10.1016/j.diabres.2012.04.019

Newton, B. (2014). Development and evaluation of an online self-help program for perfectionism using cognitive therapy and acceptance concepts. [Health & Mental Health Treatment & Prevention [3300]]. Retrieved 1 January 1974, from http://gateway.proquest.com/openurl?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&res_dat=xri:pqm&rft_dat=xri:pqdiss:3562215

NHS Education for Scotland (2011). The Matrix: Mental Health in Scotland: A Guide to delivering evidence-based Psychological Therapies in Scotland. Retrieved on 17.1.15 from: http://www.nes.scot.nhs.uk/media/20137/Psychology%20Matrix%202013.pdf

NICE (2006). Computerised Cognitive Behavioural Therapy for Depression and Anxiety: Nice Technology Appraisal Guidance. Accessed on 7.1.16 from https://www.nice.org.uk/guidance/ta97

NICE (2009). Depression in adults: The treatment and management of depression in adults Accessed on 10.12.15 from: http://www.nice.org.uk/guidance/cg90/chapter/1-recommendations

Pai, A., & Ostendorf, H. M. (2011). Treatment Adherence in Adolescents and Young Adults Affected by Chronic Illness During the Health Care Transition From Pediatric to Adult

Health Care: A Literature Review. *Children's Health Care*, *40*(1), 16–33. http://doi.org/10.1080/02739615.2011.537934

Pal, K., Eastwood, S. V., Michie, S., Farmer, A. J., Barnard, M. L., Peacock, R., ... & Murray, E. (2013). Computer-based diabetes self-management interventions for adults with type 2 diabetes mellitus. Cochrane Database Syst Rev, 3.

Peachey, D. Hicks, V. and Adams, O., (2013). An Imperative for Change Access to Psychological Services for Canada. Accessed on 10.12.15 from http://www.cpa.ca/docs/File/Position/An_Imperative_for_Change.pdf

Piaget, J. (1964). Part I: Cognitive development in children: Piaget development and learning. *Journal of research in science teaching*, *2*(3), 176-186.

Piaget, J. (2008). Intellectual Evolution from Adolescence to Adulthood. *Human Development*, *51*(1), 40–47. http://doi.org/10.1159/000112531

Pots, W., Fledderus, M., Meulenbeek, P., ten Klooster, P., Schreurs, K., & Bohlmeijer, E. (2016). Acceptance and commitment therapy as a web-based intervention for depressive symptoms: randomised controlled trial.

Recommendation from the Community Preventive Services Task Force for Use of Collaborative Care for the Management of Depressive Disorders. (2012). *American Journal of Preventive Medicine*, *42*(5), 521–524. http://doi.org/10.1016/j.amepre.2012.01.010

Renders, C. M., Valk, G. D., Griffin, S. J., Wagner, E. H., Eijk van, J. T., & Assendelft, W. J. J. (2001). Interventions to Improve the Management of Diabetes in Primary Care, Outpatient, and Community Settings: A systematic review. *Diabetes Care*, *24*(10), 1821–1833. http://doi.org/10.2337/diacare.24.10.1821

Richards, D. A., & Bower, P. (2011). Equity of access to psychological therapies. *The British Journal of Psychiatry*, *198*(2), 91–92. http://doi.org/10.1192/bjp.bp.110.083485

Ritchie, J., & Lewis, J. (Eds.). (2003). *Qualitative research practice: a guide for social science students and researchers*. London ; Thousand Oaks, Calif: Sage Publications.

Ritchie, J., Spencer, L., Bryman, A., & Burgess, R. G. (1994). Analysing qualitative data. *London: Routledge*, *3*.

Savage, E., Farrell, D., McManus, V., & Grey, M. (2010). The science of intervention development for type 1 diabetes in childhood: systematic review: Intervention development for childhood diabetes. *Journal of Advanced Nursing*, *66*(12), 2604–2619. http://doi.org/10.1111/j.1365-2648.2010.05423.x

Schwandt, T. A. (2000). Three epistemological stances for qualitative inquiry. *Handbook of qualitative research*, *2*, 189-213.

Scottish Government (2005). Delivering for Health. Retrieved on 19.1.15 from: http://www.scotland.gov.uk/Resource/Doc/76169/0018996.pdf

Scottish Government (2015) Stepped care model: Increasing the Availability of Evidence-Based Psychological Therapies in Scotland. Retrieved on 19.1.15 from *www.gov.scot/Resource/Doc/924/0051490.doc*

SIGN (2010). Scottish Intercollegiate Guidelines Network. Non-pharmaceutical management of depression in adults: A national clinical guideline. Retrieved on 17.1.15 from: http://www.sign.ac.uk/pdf/sign114.pdf

Singh, S. P. (2009). Transition of care from child to adult mental health services: the great divide. *Current Opinion in Psychiatry*, *22*(4), 386–390. http://doi.org/10.1097/YCO.0b013e32832c9221

Smith, J., & Firth, J. (2011). Qualitative data analysis: the framework approach. *Nurse Researcher*, *18*(2), 52–62. http://doi.org/10.7748/nr2011.01.18.2.52.c8284

Statista (2015). Number of mobile app downloads2009-2017/Statistic. 19.1.15 Retrieved from: http://www.statista.com/statistics/266488/forecast-of-mobile-app-downloads/

Steinberg, L. (2005). Cognitive and affective development in adolescence. *Trends in Cognitive Sciences*, *9*(2), 69–74. http://doi.org/10.1016/j.tics.2004.12.005

Svensson, J., Lyngaae-Jørgensen, A., Carstensen, B., Simonsen, L. B., Mortensen, H. B., & Danish Childhood Diabetes Registry. (2009). Long-term trends in the incidence of type 1 diabetes in Denmark: the seasonal variation changes over time. *Pediatric Diabetes*, *10*(4), 248–254. http://doi.org/10.1111/j.1399-5448.2008.00483.x

Taddeo, D., Egedy, M., & Frappier, J. Y. (2008). Adherence to treatment in adolescents. *Paediatrics & child health*, *13*(1), 19-24.

Thorsell, J., Finnes, A., Dahl, J., Lundgren, T., Gybrant, M., Gordh, T., & Buhrman, M. (2011). A Comparative Study of 2 Manual-based Self-Help Interventions, Acceptance and Commitment Therapy and Applied Relaxation, for Persons With Chronic Pain: *The Clinical Journal of Pain*, *27*(8), 716–723. http://doi.org/10.1097/AJP.0b013e318219a933

Trompetter, H. R., Bohlmeijer, E. T., Veehof, M. M., & Schreurs, K. M. G. (2014). Internet-based guided self-help intervention for chronic pain based on Acceptance and Commitment Therapy: A randomized controlled trial. *Journal of Behavioral Medicine*. http://doi.org/10.1007/s10865-014-9579-0

Twohig, M. P. (2012). Acceptance and Commitment Therapy. *Cognitive and Behavioral Practice*, *19*(4), 499–507. http://doi.org/10.1016/j.cbpra.2012.04.003

University of Alabama (2015). *School of Public Health:* Accessed on 26.06.15 from: http://www.soph.uab.edu/Statgenetics/People/MBeasley/Courses/EffectSizeConversion.pdf

Villatte, J. L., Vilardaga, R., Villatte, M., Plumb Vilardaga, J. C., Atkins, D. C., & Hayes, S. C. (2016). Acceptance and Commitment Therapy modules: Differential impact on treatment processes and outcomes. *Behaviour Research and Therapy*, *77*, 52–61. http://doi.org/10.1016/j.brat.2015.12.001

Viklund, G., & Wikblad, K. (2009). Teenagers' perceptions of factors affecting decision-making competence in the management of type 1 diabetes: *Teenagers' perceptions of factors affecting decision-making competence*. *Journal of Clinical Nursing*, *18*(23), 3262–3270. http://doi.org/10.1111/j.1365-2702.2009.02963.x

Vine. R., (2011). Equity in health and wellbeing: Why does regional, rural and remote Australia matter? *InPsych.* Accessed on 10.12.2015 from: https://www.psychology.org.au/Content.aspx?ID=3960

Wierzbicki, M., & Pekarik, G. (1993). A meta-analysis of psychotherapy dropout. *Professional Psychology: Research and Practice*, *24*(2), 190.

Winkley, K. (2006). Psychological interventions to improve glycaemic control in patients with type 1 diabetes: systematic review and meta-analysis of randomised controlled trials. *BMJ*, *333*(7558), 65–0. http://doi.org/10.1136/bmj.38874.652569.55

Yardley, L. (2000). Dilemmas in qualitative health research. *Psychology & Health*, *15*(2), 215–228. http://doi.org/10.1080/08870440008400302

Yuen, E. K., Herbert, J. D., Forman, E. M., Goetter, E. M., Comer, R., & Bradley, J.-C. (2013). Treatment of Social Anxiety Disorder Using Online Virtual Environments in Second Life. *Behavior Therapy*, *44*(1), 51–61. http://doi.org/10.1016/j.beth.2012.06.001

Appendices

Appendix 1. Guidelines for Publication

Full guidelines from JCBS found at:
http://www.elsevier.com/wps/find/journaldescription.cws_home/727090?generatepdf=true
Overview:
Review articles (up to 10,000 words)
Empirical research (up to 6000 words)
Word limits exclude references, tables and figures but include the abstract
Please write your text in good English (American or British usage is accepted, but not a mixture of these)
References Citation in text using American Psychological Association, Sixth Edition.
Any references cited in the abstract must be given in full.